AMERICAN ENGINEER AND RAILROAD JOURNAL.

APRIL, 1899.

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THE LOCOMOTIVE "CENTIPEDE."

By M. N. Forney.

The following description of a "monster locomotive" is from an old paper, of which the date was not obtainable, but in all probability it was about the year 1855.

"A Monster Locomotive—A locomotive engine for the Baltimore and Ohio Railroad has just been constructed in Baltimore, which is said to be the largest in the United States or in the world. Its size and peculiarities of construction are as follows: It has 12 wheels 44 inches in diameter, 22 inch stroke, 11 feet fire box, and weighs 33 tons. This engine has been built as an experimental one, to test the practicability of drawing a train of six passenger cars up the heavy grades on the road (of which some are 117 feet to the mile) at the rate of 25 miles per hour. This engine presents a singular appearance from those now in use; one striking feature is that the engineer stands in front."

This description undoubtedly refers to a locomotive designed by Mr. Thomas Winans, which was built in the shops of his father, Ross Winans, in Baltimore, and was called the "Centipede." At that time the writer was employed there, and remembers the engine very distinctly, as it was a novelty, and interested all of us chaps who were then young.

The drawings of the locomotive were made by Mr. Frederick B. Miles, now of the firm of Bement, Miles & Co., of Philadelphia. The general design was similar to that of the Camel engines, then built in the Winans shops. They had four pairs of driving-wheels, all located between the fire-box and smoke-box. The fire-box was of the form so long used by Winans, and had a flat top, which sloped downward and backward from the barrel of the boiler, and was stayed to the crown-sheet by stay-bolts. The grate, as stated in the above description, was about 11 feet long, and the outside of the fire-box was made of as great a width as it was possible to get between the wheels. Besides this it had a combustion chamber in front. This form of engine was lengthened out in front sufficiently to get a four-wheeled truck under the smoke-box, the wheels of which were spread 66 inches. The weight of the overhanging fire-box behind was partially balanced by placing the cab in front over a foot-board ahead of the smoke-box. The fireman occupied a platform on the tender in firing.

Besides the location of the cab, there were a number of other peculiarities in the design and construction of this machine. It had what was probably the first example of a lateral motion truck used under a locomotive. The smoke-box was of the old-fashioned rectangular form, made of plate iron. Below its bottom plate was a casting with an elongated cup-shaped cavity, which was underneath. The truck itself had a similar casting with the cup on top. A cast-iron roller was placed in the cavity thus formed, between the two castings, a section of which arrangement was somewhat like this: As the smoke-box was not confined on the truck laterally, excepting by the roller and cups, it is plain that it could move sideways on a curve, and that when it did so, the roller would roll up the inclined surfaces, and would therefore have a tendency to resume its central position on a straight line.

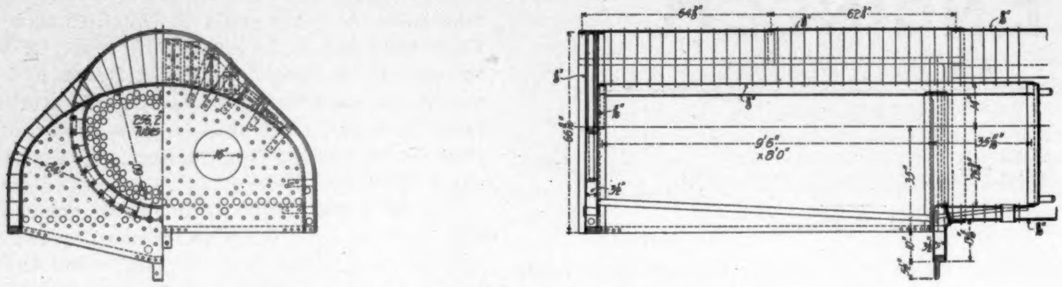
Another peculiarity in the truck was that the journal bearings extended the whole length of the axles between the hubs of the wheels. Wrought-iron plates were bent into the form of an inverted letter ∩, and were placed astride of the axles. A number of brass-bearings were placed on top of the axles, between them and the ∩ shaped plates, and as stated, accupied the whole length of the axles between the hubs. On the lower portion of the ∩ shaped plates, flanges were turned outward. To these the springs were bolted. They were of somewhat greater length than the distances between the centers of the wheels, so that they could be bolted to each of the flanges on the lower edges of the plates. There were six or eight of these springs which formed the truck frame, and the center plate, containing the cup-shaped cavity, was attached to the top of these springs. Hook-head bolts were arranged so as to prevent the top casting from raising more than a limited distance above the lower one.

The valve-gear consisted of double valves on each cylinder. The lower or main valve was worked by two eccentrics, whose rods were attached and detached from the rockers by old-fashioned hooks. The cut-off valve was worked by a link. These valves were very large, and considerable difficulty was encountered from their cutting, and some kind of a balancing arrangement was applied to them after the engine had been running a short time.

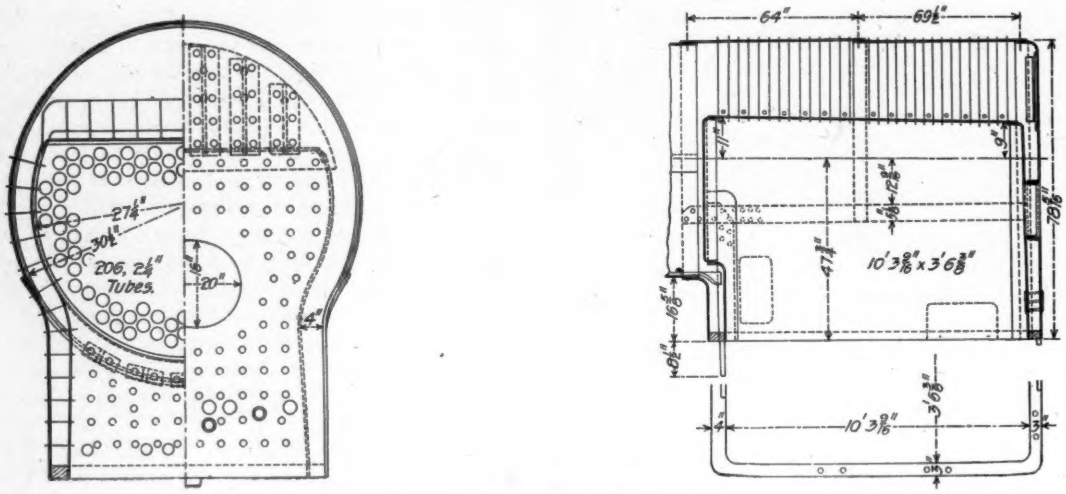
Short stroke pumps were used, which were driven by a link, so that the stroke of the pump could be adjusted. The pumps were located between the frames and below the boiler. The upper ends of the links were pivotally connected to brackets riveted to the boiler, and an eccentric rod was connected to the lower end of each of them. A sliding block was arranged in the link in the usual way. Radius rods were connected to the blocks, and to the pump plungers. When the blocks were at the lower ends of the links the full throw, or somewhat more, than that of the eccentrics was imparted to the plungers. When the block was raised to the top of the links the throw was reduced to nothing. This arrangement always seemed to the writer to be a very good one, as it permitted the amount of feed to be adjusted to the consumption of water by the boiler, which is impossible with a pump having an unvarying stroke or with an injector.

This engine was placed on the Baltimore & Ohio Railroad, and was run experimentally for some time between Baltimore and Washington, and the writer remembers going from Baltimore to Washington and back several times on this machine. It was finally laid up in Winans shop, but during the Civil War he had a number of completed camel locomotives, which the Baltimore & Ohio Company needed very badly. They made an offer for the engines, to which Winans responded that they could have them at a price agreed upon, if they would take the "Centipede" with the others at the same price, which they were compelled to do. It was then sent up to Piedmont and was used there for some time, but finally went to the bourn, which is ultimately reached by all locomotives—the scrap heap.

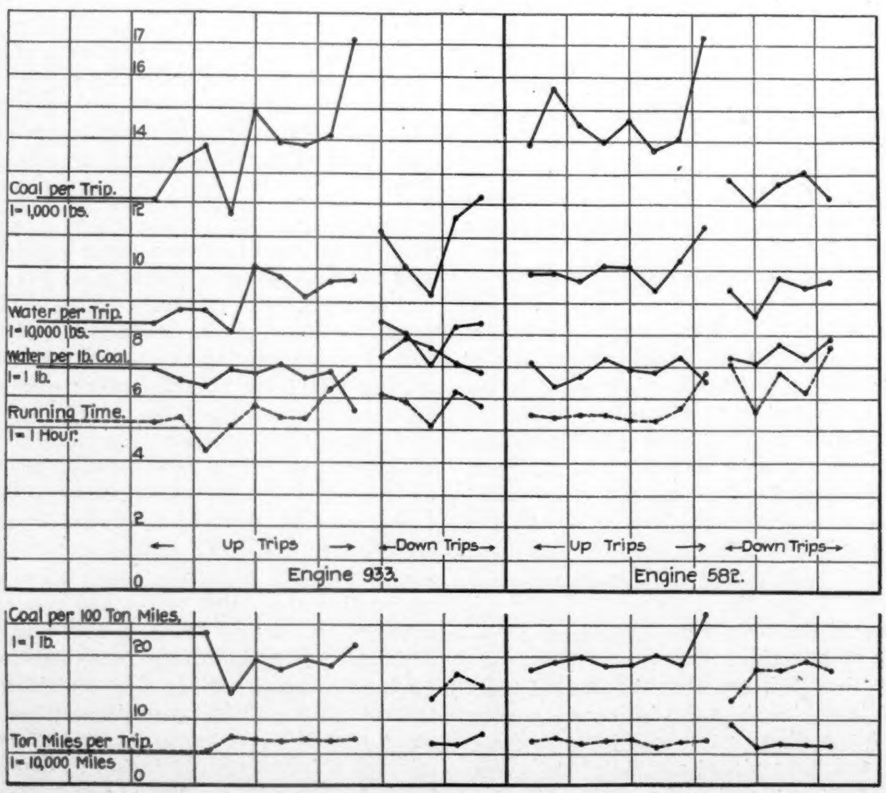
The cold weather of this winter has resulted in devising a method for thawing frozen water pipes that will revolutionize and make comparatively easy what has been a most exasperating problem. The discovery of the value of electricity as the agent for thawing was made and applied by an instructor of electrical engineering at the University of Wisconsin. Some particulars of the electric energy required are gathered from information furnished inquirers by Prof. C. K. Adams, as follows: "The source of electric power which is required in thawing pipes should be capable of producing 300 amperes of electric current, with a pressure of from 50 to 60 volts. This power may be obtained by means of an alternating current transformer connected with electric light lines or any other similar source. Whenever several pipes in a city are frozen we advise that the water works and electric light companies be asked to join in the effort to facilitate the work of thawing. Although up to the present time experience has been chiefly confined to service pipes, the method is applicable to street mains in case sufficient power is obtainable. It has been computed that 75 horse-power is required to thaw out within 30 minutes a frozen main 6 inches in diameter for a distance of 100 feet. For a longer distance corresponding power would be required. It is ordinarily found that the time needed for thawing any length of pipe less than 200 feet does not exceed half an hour after the electricity is applied."



Wide Firebox, Wootten Type, Engine No. 582.



Narrow Firebox, Engine No. 933.



Plotted Results of Tests.

TESTS ON WIDE AND NARROW FIREBOXES.—BITUMINOUS COAL.

PHILADELPHIA AND READING RAILWAY.

TESTS ON WIDE AND NARROW FIREBOXES.

Philadelphia & Reading Railway.

By H. H. Vaughn.*

It recently became necessary on the Philadelphia & Reading Railway to ascertain the relative efficiency of locomotives with the ordinary types of narrow firebox and those with fireboxes of the wide or Wootten type when burning bituminous coal. Experiments to determine the best proportion of grate that should be blocked off for economical reasons from a firebox 8 feet by 9 feet 6 inches had shown that there was a slight gain in evaporative efficiency by using the full grate area, and that in addition a larger nozzle could then be used with a diminution in the amount of sparks thrown, and this led to the belief that the wide firebox would prove as economical as the narrow for soft coal, with the advantage that it could be used for burning small anthracite if required. Through the courtesy of Mr. E. E. Davis, Assistant Superintendent of Motive Power of the road this account of the tests has been prepared for the "American Engineer."

There being no available data for locomotives with this type of firebox, a test was decided on, and for this purpose two engines were selected, identically alike with the exception that one, No. 933, was built with a straight top boiler with its firebox above the frames, and the other, No. 582, had been rebuilt from the same class with a Wootten firebox.

The leading dimensions were as follows:

	No. 933.	No 582.
Cylinders	20 by 24 in.	
Drivers	50½ in.	
Boiler diameter	60 in.	
Firebox	42⅝ by 123½ in.	96 by 114 in.
Heating surface, tubes	1,617 sq. ft.	1,420 sq. ft.
" " firebox.	157 sq. ft.	199 sq. ft.
" " total	1,774 sq. ft.	1 619 sq. ft.
Grate area	36.3 sq. ft.	76 sq. ft.
Boiler pressure	145 lbs.	
Weight on drivers	110,000 lbs.	103,000 lbs.

Both engines were fitted with rocker grates with ¾-inch spaces and ¾-inch bars in No. 933, and with ⅝-inch spacers and ¾-inch bars in No. 582. No. 933 had the Master Mechanics' Association arrangement of front end, No. 582 had a low exhaust with hopper netting, probably a slightly more efficient arrangement. The difference in heating surface is caused chiefly by the loss of tube length due to the Wootten combustion chamber, and the heavier weight of No. 933, partly on account of that firebox being stayed by crown bars, No. 582 being direct stayed. The test was continued for about six weeks, the engines running in coal service between Palo Alto and Richmond, a distance of about 94 miles, and pulling trains of about 50 loaded cars down and 60 empties up, the grade averaging about 6 feet per mile. The trains were kept as uniform in weight as possible, and in most cases were pulled through without setting out or picking up cars. The coal used throughout was known as Beech Creek, and although instructions were given at the coal docks to keep the quality uniform, no doubt it varied to a certain extent.

The fires were not brought to the same height when finishing a run as at starting because this was not strictly an evaporative test, but was made to determine the amount of coal required in service. Since the ton mile would be liable to give widely varying figures on account of delays, difference on train resistance, etc., the water evaporated was taken as the measure of the work done, but the fires were kept as low as possible on leaving the round house and brought in at the end of the run with enough coal to enable them to be cleaned, just as in regular running. The same fireman was employed throughout the entire test and every endeavor made to do this as uniformly as possible. The coal used to bank fires after cleaning is thus unaccounted for, but the extent to which this is burned would vary with the length of time in the house and would not affect the results appreciably on so long a run.

* Mechanical Engineer, Q. & C. Co. Formerly Mechanical Engineer, Philadelphia & Reading Railway.

The water was measured by two gauge glasses, one on each side of the tank, placed on a line passing through the center of gravity of the surface of the water and the same tank was used for both engines. The tank was calibrated by filling it with water to a point near the top of the gauge glasses, weighing it, and draining the water off from three to six inches at a time, and taking the weight at each point. The weight per inch thus obtained can be relied on within 50 lbs. on the entire tank full of water. In running, the tank was never filled entirely since this method has been found to introduce considerable error, but water always showed in the glass so that the inches of water used could be accurately measured. Since from 20 to 30 inches were usually taken at a time and the height may be read accurately to ⅛-inch, this method is exceedingly accurate. To bring the water to rest quickly three rows of wash boards were fitted across the tank which permitted of measuring the level within a minute or so after stopping.

The weight of coal used was obtained by filling the tender on leaving the round house and taking the height of the water, cutting off the tender and weighing it on track scales. At the end of the run the tank was filled to about the same height, cut off and weighed; the allowance for the variation in the water is then small and unlikely to cause error. The track scales used were in good condition and accurate within 25 or 50 lbs. No material was allowed to be placed on the tank between the beginning and end of a run unless weighed. The water used in wetting down the coal before starting was deducted from the quantity in the tank; on the run the coal was wetted while water was being taken. This precaution is rather fine but it has the effect of preventing 200 lbs. or more water being weighed as coal. An allowance was made for the number of times the injector was used. The boiler pressure was taken every five minutes and time popping, delayed and switching, and minutes blower was used, were all noted, as much to keep the inspector busy as for any other reason. The inspector, who took all measurements, etc., was a bright young fireman, and he looked after everything connected with the test, his practical knowledge enabling him to keep all conditions as uniform as possible.

Two engineers were employed owing to the necessity for one of them to take an enforced vacation. The fifth up and fourth down trips of engine No. 933 and all the succeeding trips were made by the second man who was not by any means as good a runner as the first.

While the evaporative figures are from Palo Alto to Richmond, on account of shipping conditions, serious delays were met with between Richmond and West Falls, a distance of about six miles. The ton mile figures are therefore made from Falls to Palo Alto by noting the water used for that distance, and assuming that the coal is in the same proportion. The ton mile figures are from actual weights of car and lading. The accompanying diagram represents graphically the results of the tests showing such runs of No. 582 as were reliable and a corresponding number for No. 933. The diagram shows for each run the pounds of water and coal used, the water evaporated per pound of coal, the actual running time, including one-half the time switching, the ton miles, and the coal per 100-ton miles. These are all the figures of importance. An inspection of the diagram will show that on the whole the results are fairly uniform, and such variations as occur can be safely said to be inherent in a road test. The boiler pressure was throughout close to the maximum, the average varying from 128 to 141 for No. 933, and 132 to 141 for No. 582, both engines steaming freely. The total time on the road is not plotted but has no effect on either the evaporation or ton mile figures that is comparable to the amount of variation. Both ton mile and evaporation figures have been plotted with running time and total time on road as abscissæ without showing any relation to these factors, and the figures for coal per ton mile have been plotted with ton miles per trip as abscissæ with the same result. The variation in the figures for evaporation is probably not in ex-

cess of what must always be expected, and simply shows the danger of basing conclusions on isolated tests. By making a large number of trips, and plotting the results the general run of the work can be judged, and the effect of extraordinary trips either good or bad allowed for. On the whole it is seen that the Wootten boiler gives slightly better figures for evaporation, but hardly enough to say that it is actually superior. It may however be safely concluded that it is certainly equal to the narrow type. On the ton mile basis No. 933 shows the lesser consumption, but this can hardly be considered as accurate a measure of the boiler efficiency as the water evaporated, since there is a possibility of the engine affecting the results.

On the whole, the test is interesting as showing at least that there is no loss in economy in using a larger grate under the conditions of this test, and there would also appear to be no reason for the economy of the wide firebox falling off if the work done once increased since the rate of combustion would then approach more closely that of the narrow firebox, while under an increased duty the latter would probably show a decrease in efficiency, due to the greater spark loss which at the rate of combustion in this test, was small. If this premise be granted, it would open an interesting question as to whether an engine with a wide firebox is not worth considering as a soft coal burner. The boiler under test, designed exclusively for anthracite, and with a height of only 40 inches from the grate to the crown sheet is, of course, too low for satisfactory results, but the center of the boiler is only 7 feet 6 inches from the rail and would thus leave room for a deeper box if desired. With the crown sheet so near the fire, not only must the combustion be interfered with, but on account of the intense heat near the door, the crown sheet seams give trouble from leaking.

A curious point about these engines when burning soft coal is the intense heat in the front end, this occurring even in engines that were steaming poorly and without any accumulation of cinders, and generally showing near the flue sheet. It could hardly be due to flame continuing through the flues, although only 10 feet 7 inches long since in that case there should have been ample steam, and occurring in engines fitted with the Master Mechanics' Association front end, and a large stack it was possibly due to combustion of the unburned gases by air admitted by the stack, an unwelcome application of the Schlicht system. Still with proper front end arrangements the wide firebox engine may be depended on never to give trouble for want of steam, with any kind of coal, and will burn fine coal in hard service without its being pulled through the flues to anything like the extent occurring in a narrow firebox engine. Free steaming is a strong point in a freight pulling machine, and while it is not an attribute of the Wootten boiler alone, it certainly is one of its strong points, and if not sufficient to recommend its use for engines burning bituminous coal exclusively, it justifies its application where there is any chance of burning anthracite.

The largest hydraulic press in the world has been recently completed at the Parkbend Forge, England. According to the "American Machinist" this machine is capable of exerting a pressure of 12,000 tons and is to be used in making armor plate. It is built of nickel steel and the cylinder is 6 feet in diameter weighing 42 tons complete. The foundation for the press is composed of 1,300 tons of bricks and a bed of concrete weighing 330 tons. The power is supplied by four sets of coupled compound condensing engines with cylinders 21 and 43 inches and 18 feet stroke. The steam pressure actuates 68 pumping rams each 1 11-16 inches in diameter which deliver the water to the main cylinder of the press. To lift the press face, crosshead and ram, two return cylinders are used working at a pressure of 1,300 lbs. per square inch.

66-FOOT CAR FOR STEEL RAILS.

LAKE TERMINAL RAILROAD.

The Lake Terminal Railroad, of the Lorain Steel Company, is having some long gondola cars built for the transportation of 62-foot steel rails, and we are enabled to illustrate them by the courtesy of Mr. F. H. Stark, Master Car Builder of the Cleveland, Lorain and Wheeling, who designed the cars. The cars are to carry 80,000 pounds, either with long or short material, and if the latter, the load must be equally distributed for a distance of 18 feet from each end, and instructions to that effect will be stenciled on the sides. The length over sills is 66 feet 4 inches and width over sides and sills 8 feet 11 inches, while the distance between centers of bolsters is 53 feet 8 inches, dimensions that convey the idea of immense proportions for freight service. There are eight sills of the following dimensions: Outside, 5 by 14 inches; four intermediate, 4 by 8 inches, and center sills, 4½ by 8 inches, all of Georgia pine. The end and side planks are 4 by 12 inches, and also of Georgia pine.

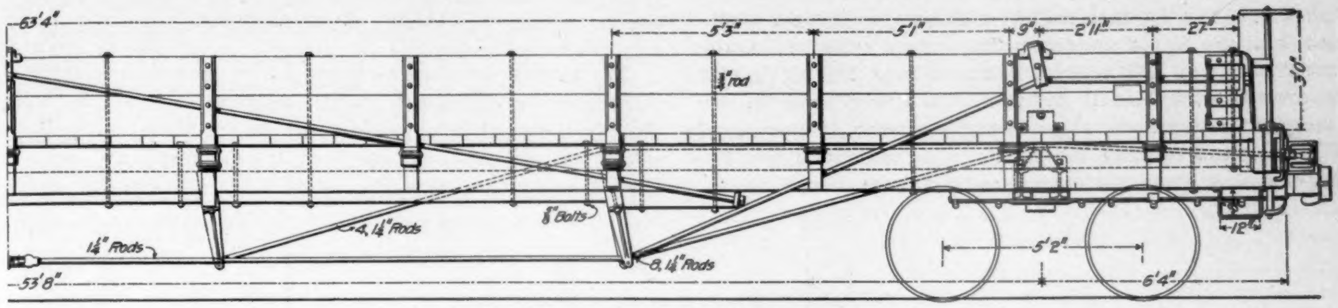
The length of the car necessitates four crosstie timbers, 5 by 12 inches, of oak, and the end sills are of the same material, 10 by 12¼ inches and faced on the outside with ¾ by 10-inch wrought iron plates, for the purpose of resisting the pull of the truss rods, of which there are eight, passing through the end sills, and two seating against the gondola sides at each side, making twelve truss rods in all to sustain the car and load between the bolsters. The truss rods are 1¼ inches in diameter with ends upset to 1¾ inches in diameter, and having special forged open turn buckles tapped for 1¾-inch ends. Since the truss rods occupy such an important place in a car of this length, every provision is made to render them as effective as possible. To this end the four outside rods are carried in a wrought iron stirrup, which in turn rests in a malleable iron saddle on top of the side planks, directly over the body bolster, the bearing having such an area as will safely distribute the crushing component of the truss rod pull, while the compression due to same cause at the side planks is taken care of by seating washers of liberal area.

Four of the longitudinal truss rods, after crossing the first pair of crosstie timbers, transmit their load to the second, or outer pair of crosstie timbers, and pass from there to the end sills. These rods take care of the load at the center of the car, while the remaining eight rods transmit the load to the bolsters. To obviate the danger of buckling at the center, due to compressive shocks, there are four counter truss rods, 1⅛ in diameter with 1½-inch ends, which are supported at the center of the car in a stirrup and saddle similar to that for the longitudinal rods, the ends passing down near the outer crosstie timbers, against which a block abuts, which receives the pull of the rods.

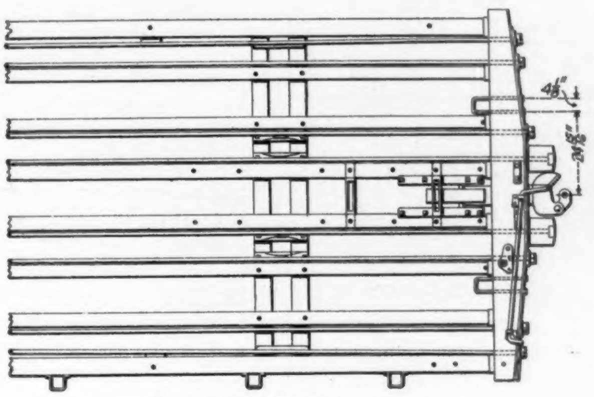
The longitudinal sills rest in malleable iron pockets, that are secured to the inner face of the end sills by ½ by 3-inch lag screws. There is a permanent floor bolster, 6 by 8 inches in section located over the body bolster, which will support the rails at the ends and allow the car to be trussed with about 4 inches of camber at the center, and then leave the load approximately level. In order that there shall be no resistance to camber from the side planks, they will be cut on the lower edge to a height of three inches at the center of the car, and running out by a true curve to the body bolsters, leaving the side planks the full depth of 12 inches from bolsters to the end of the car.

A special form of the Bettendorf I beam body bolster has been furnished for these cars by the Cloud Steel Truck Company, of Chicago.

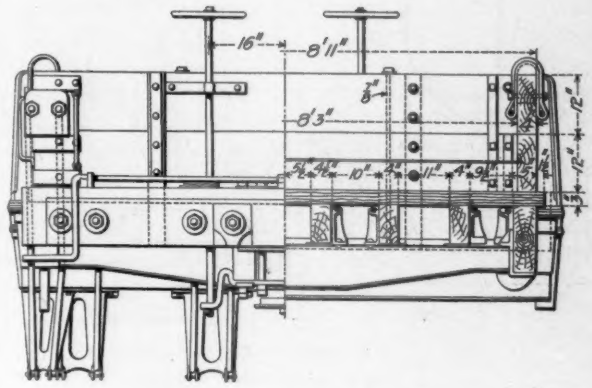
A draft gear of exceptional strength is provided for these cars. There are two double coil draft springs placed side by side between the center sills, the springs having a diameter of 1 3-16 inches for the outer coil and 11-16 inch for the inner, with a diameter over the coil of 6 inches and a length of 8



Half Side Elevation, Showing Trussing.



Partial Plan of Underframe.



End Elevation and Section.

The Common Sense Bolster.

Note—This drawing shows the construction of this type of body and truck bolster. The body bolsters of the car are the "Bettendorf."

66-FOOT CAR FOR STEEL RAILS—LAKE TERMINAL R. R.

Designed by Mr. F. H. Stark, *Master Car Builder, Cleveland, Lorain & Wheeling R. R.*

inches. This arrangement doubles the capacity of the draft springs and is a much needed improvement over the so-called standard. The 1½-inch followers are much stronger than if used with the single central spring. As a safeguard against undue strain on the vertical draft bolts, a 2½ by ⅝ strap is provided, with the end bent to fit into a mortise in the draft timber, while the body, 1⅛ inches in diameter, is made to extend back and through the bolster with a nut and cotter on the end. A centering device, consisting of two springs of 9-32 inch bar, 1¾-inch diameter, which are held in a malleable iron pocket on the inner face of the draft timbers, centers the drawhead and permits of a lateral movement of about 1½ inches each side of the center. This draft gear is a substantial one and ought to give the best of service.

The truck bolster is the "Common Sense" type, with an upper and lower steel plate, ⅝ by 12 inches, and a flanged filling piece riveted to both plates. The trussing depth at the center is 11½ inches and the weight, 625 pounds, which is not an excessive weight when the capacity of the car is considered. Our illustration shows the common sense truck bolster and body bolster in order to make clear the construction of both. The body bolster, however, is not used in this car, which has the Bettendorf bolster as stated above. The truck is of the arch bar pattern, and designed for the load. Aside from these features the drawings need no explanation.

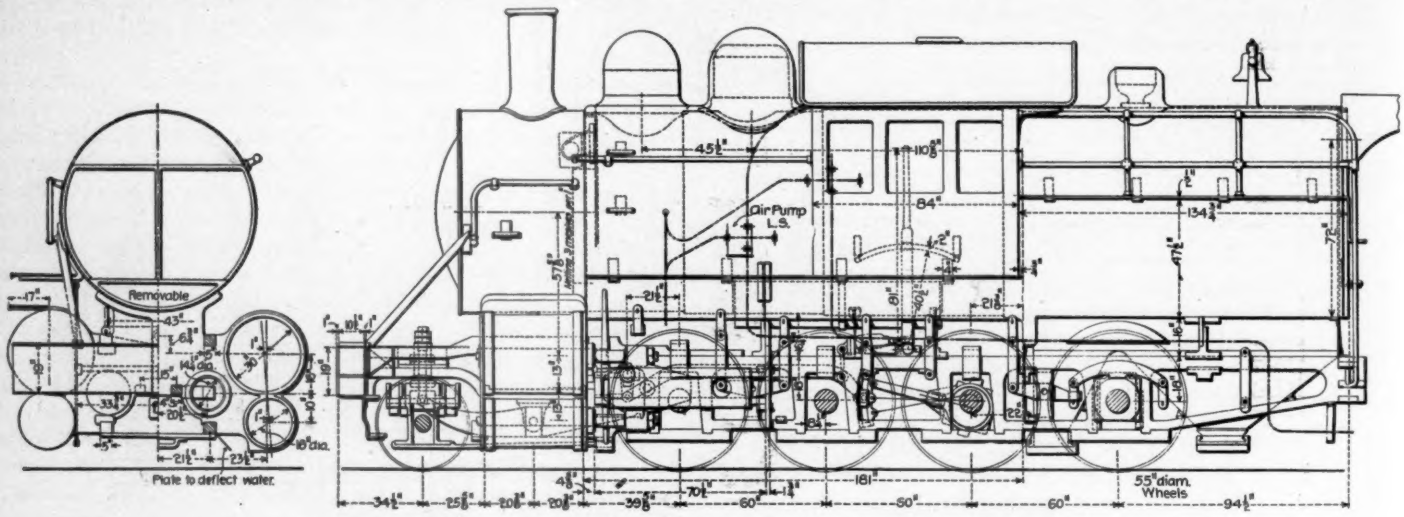
MULTIPLEX PRINTING TELEGRAPH.

A system of printing telegraphy, known as "Prof. Rowland's Multiplex," was recently tested between Philadelphia and Jersey City with highly satisfactory results. As its name implies, a message is sent and received in legible and easily read type, transmitted from keyboards similar to those of a typewriter, the characters including simply the ordinary alphabet and numerals. The device on trial was made at the Johns Hopkins University in order to demonstrate what merits it possessed and also its weakness, if any, and it is arranged for eight messages, four in each direction, and duplexed in the usual way. The messages are printed on either a tape or a page, and a speed of sixty words a minute has been obtained in some of the experiments, but the limit of speed or the number of messages was not reached. There is no other multiplex printing system sending from a keyboard and received on a page, and this one is only a part of that invented by Professor Rowland. The whole invention contemplates a relay method, by which any amount of territory may be covered, and comprises a system by which eight people in one city can be in communication with eight others in another place over one wire and with absolute secrecy. Among the advantages claimed for the multiplex system is that of less liability of error, since there is only one person engaged, and he the sender; while, by the Morse system, there is an opportunity for mistakes at each end of the line.

CONSOLIDATION FREIGHT LOCOMOTIVES.

Lehigh Valley Railroad.

The general dimensions of the heavy mountain pushing locomotive recently built by the Baldwin Locomotive Works for the Lehigh Valley were given in our issue of December, 1898, page 395, and on page 11 of the January, 1899, issue the boiler and tender were illustrated. We now present an elevation drawing of this engine which we believe to be the most powerful locomotive ever built, and it is next to the heaviest. The satisfactory performance of this engine has led to the ordering of nine more from the same drawings. The chief object in presenting the drawing at this time is to show the comparison between the heavy pushing engines and a new design of the consolidation type for road service on the division between Buffalo and Sayre, which is also illustrated. In the engravings the smaller engine is made to a larger scale because more details are shown, but the dimensions show the difference at once.



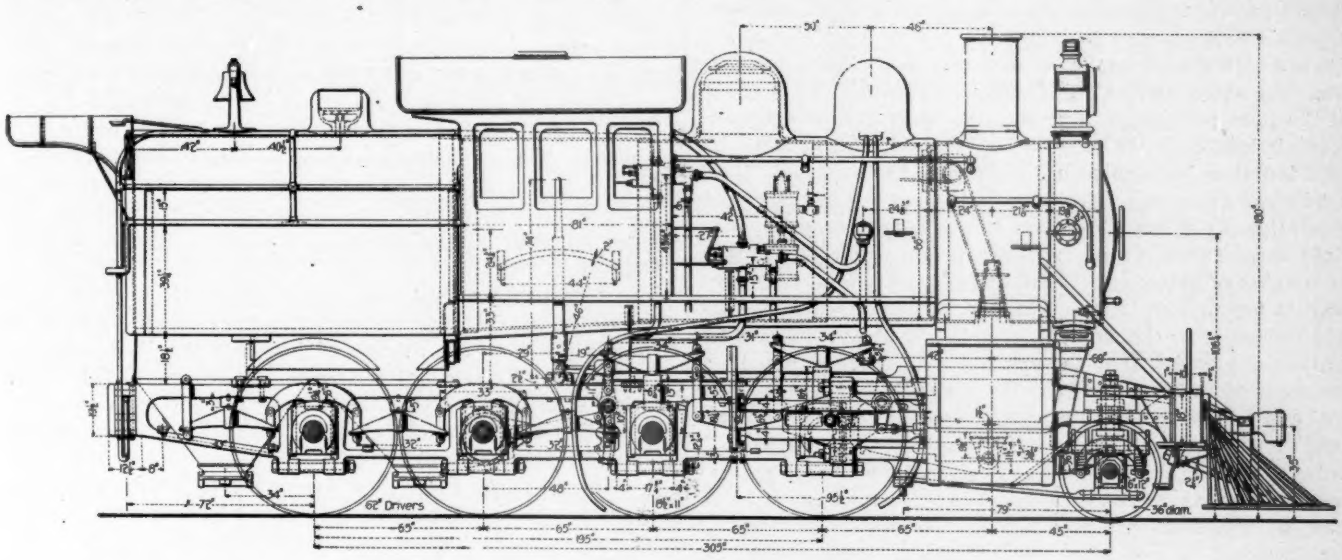
Compound Consolidation Mountain Pushing Locomotive—Lehigh Valley R. R.
[For description see "American Engineer," December, 1898, page 345, and January, 1899, page 11.]

The lighter engines, of which two are now building at the Baldwin Locomotive Works, are intended for service on the Buffalo division, where there are some long grades. One grade is 21 fet per mile and 37 miles long, and another is 18 feet and 30 miles long. They are to pull 2,000 tons, exclusive of the weight of the engine and tender, and each is to do the work of two of the locomotives in present use in this district. One of the engines is a Vauclain compound, with cylinders 17 and 28 by 30 inches, while the other is a simple engine with 21 by 30 inch cylinders, all features except the cylinders being alike in the two designs, which were prepared by Mr. S. Higgins, Superintendent of Motive Power of the road, to whom we are indebted for the drawings. In the arrangement of the cylinders of the compound, it will be noticed that the center lines of the cylinders are not in the same vertical plane the low pressure cylinders having been drawn inward to reduce the width of the engines. The location of the reverse lever renders a reach rod unnecessary, and the drawing shows a number of interesting features, such as inverted rockers and continuous equalizing in the spring rigging throughout the length of the engine. The valve gear uses two sets of rockers, as indicated in the drawing. The driving wheels are all provided with flanges, which is not usual in the consolidation type, and especially with such a long wheel base. In fact, this is believed to be the longest wheel base for this type that has ever been used. We are informed by Mr. F. F. Gaines, Mechanical Engineer of the road, that 3-16-inch lateral motion is allowed on each side, between the driving boxes and wheel hubs, making ⅜ inch in all. The main and intermediate driving

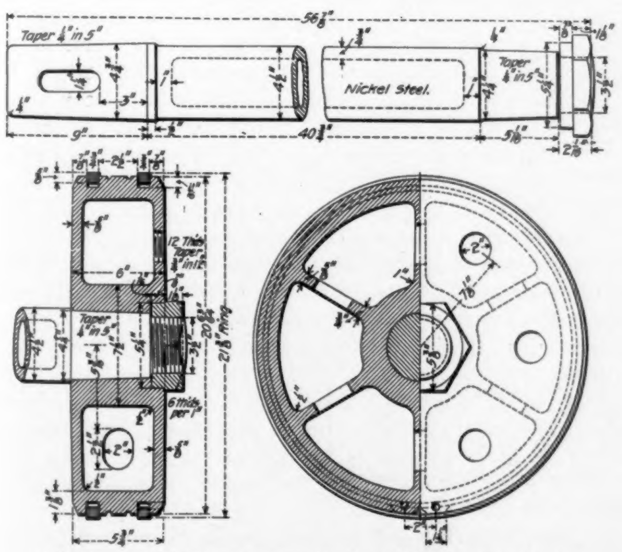
wheel tires are set at 53¼ inches, while the front and rear ones have ¼ inch less. The piston rods are of nickel steel and hollow, with a three-inch hole. The cast steel piston for the simple engine and the hollow nickel steel piston rod are illustrated. The piston is six inches thick, and very light and strong for such a large diameter.

The driving wheels of these road engines are unusually large, and will attract the attention of motive power men for the reason that small wheels have always been associated with large hauling capacity, and as that is supposed to be the prime object of building engines of the consolidation type, a large wheel appears incongruous at first sight. The character of the service these engines are intended for, however, furnishes good reasons for the increased wheel diameter. For heavy fast freight service they should be able to make a good record on account of reduced piston speed, while the advantage of having such an engine on the line for emergency passenger haulage in case of break down of the regular engine in that service, will be of no small moment on account of the apparent ability of these engines to haul heavy loads at high speed.

The simple engines are similar to the compounds in all respects except in cylinder proportions, which are 21 by 30 inches, while the compounds have cylinders 17 by 28 by 30 inches stroke. The simple engines will exert a starting power of 38,400 pounds, and have a co-efficient of adhesion of 0.25, while the draw-bar pull of the compounds will be 47,000 pounds, with an adhesion coefficient of 0.30. In each case there is seen to be a close approach to that ideal condition in design where utility is of first consideration, and nowhere, probably, can this be better illustrated than in the ratio of adhesive weight to tractive power as given above, which is plainly the present tendency in advanced locomotive practice.



Consolidation Compound Road Locomotive—Lehigh Valley R. R. With 62-inch Driving Wheels.



Piston and Hollow Piston Rod—Lehigh Valley R. R.

Comparing these compounds with the heavy compounds for mountain pushing service, it is seen that the adhesion coefficient of 0.298 of the latter bears a striking resemblance to that of the new road compound, the significance of which is, that both classes of engines will be able to exert their maximum tractive effort only on a dry or sanded rail, or in other words, they are cylindered up to the critical point of adhesion, and therefore carry no unavailable dead weight. A further comparison of the heavy pushers referred to above, with the Pittsburg 23 by 32 simple consolidation engine illustrated in the November, 1898, issue of the "American Engineer," shows the attention to the relation of weight on drivers to power developed at the rail, in the coefficient of 0.27, but hardly reaching the mark set by the Lehigh Valley. The tractive effort of the Pittsburg engine is 56,400 pounds, and the adhesive weight is 208,000 pounds, while the draw-bar pull of the Lehigh Valley pusher is 60,300 pounds, with 202,000 pounds of adhesive weight. The Pittsburg engine is the heaviest engine in the world, but must yield the palm of power to the lighter Lehigh engine.

Some of the leading dimensions are given as follows:

Cylinders, Compound	17 and 28 by 30 in.
" simple	21 by 30 in.
Driving wheels, over tires	62 in.
Rigid wheel base	16 ft. 3 in.
Total " "	25 ft. 5 in.
Height from rail to top of stack	15 ft.
Weight on driving wheels	155,000 lbs.
Total weight of engine	175,000 lbs.
Boiler pressure	200 lbs.
Boiler diameter	66 in.
Heating surface, firebox	177.7 sq. ft.
" " tubes	2809.6 sq. ft.
" " total	2987.3 sq. ft.
Firebox, length	118 in.
" width	96 in.
Tubes, 358, two inch, length	15 ft. 1 in.
Piston rods hollow, diameter	4½ in.
Driving journals	8¼ by 11 in.
All drivers flanged	
Engine truck wheels	36 in.
Water capacity of tender	4,500 gals.

LIGHT AND HEAVY CARS.

By O. H. Reynolds.

The writer has had occasion many times to notice the excessively high ratio of dead weight to paying load that is so prominent a characteristic of wooden cars, in both freight and passenger service, and has been impressed with the belief that builders of heavy cars were not serving the best interests of their employers when measuring the requirements of construction simply from the standpoint of strength, with the object of keeping the cost of maintenance at a low figure. This procedure has its analogue in the now nearly obsolete practice of allowing a locomotive to rest, with a view to prolonging its life and both are accomplished at the expense of earning capacities. The objection to a reduction of car weights on the ground of the light percentage of braking power, available when such a car is loaded, is the only one of real moment, and one that will doubtless be handled in due time in the way that all new conditions are provided for. The objection is of secondary consideration when placed against the increased capacity of the light car. There is already a strong desire for the reduction of weights of passenger trains, and there seems to be no good way to accomplish it except in the construction of the cars. The necessity for this is more forcibly brought to our attention when we consider that the load is a fluctuating one in all branches of railway service, with a possible exception in the coal and ore trade, and this serves to emphasize the contention that cars must be of light weight relative to load capacity, in order to be most productive in transportation. There are good reasons for this view, among which are the increased cost of the heavier car, and an increased fuel expense for haulage, a two-edged sword which cuts deeply into the earnings, and for which no mathematical demonstration is necessary, since it is plain that the same quantity of fuel per square foot of grate must be consumed to haul one pound of dead weight as to haul one pound of paying load, a fact of the greatest significance now that we are approaching a limit to the size of locomotives.

Freight Cars.

The loading of locomotives on a tonnage basis is largely responsible for the renewed attention to the non-paying side of the transportation question, with the result that the constantly recurring query why cars of the same nominal capacity are built so as to require different stencils for light weight, is not an easy one to answer by those that have gathered their design inspirations from the school of strength as the prime consideration. This fault is a glaring one in the wooden car, and is more in evidence perhaps in those of 40,000 pound capacity than in the later cars of greater capacity, but the fact remains that cars may be reduced in weight without impairing their usefulness as carriers, with a corresponding increase in net earnings.

Proof of this is seen in the 60,000 pound capacity box cars of the Chesapeake & Ohio, of which the light weight is only 25,000 pounds; a weight actually less than in average 40,000 pound cars. This was a 34-foot sample car of which Mechanical Engineer Hoopes, of the office of Mr. W. S. Morris, Superintendent of Motive Power, says in a letter:

"This car was built to see how light a car could be made, to carry a load of thirty tons. It is fitted with air brakes and M. C. B. couplers, was built about five years ago and placed in freight service. This car has been shopped several times for examination, and has always been found in good condition, requiring no repairs. We have another class of cars, of which we have 100, which we built with a view to having the car as light as possible. This is a stock car with feeding and watering arrangements. The car is 36 feet long inside and of 30 tons capacity, weighing 27,300 pounds. The sizes of sills are: Outside, 4x8 inches; intermediate, 3½x8 inches, and center, 4x8 inches. This car has eight sills. The posts and braces being made as light as consistent with the required strength. The flooring, side slats, etc., are grooved. This manner of making the flooring we find to be a great benefit to the car aside from reducing the weight, as it allows a circulation of air between the tops of the sills and the flooring, and it causes the moisture to dry out much sooner than it would otherwise. We believe that there is entirely too much timber put in most freight cars, and not enough attention given to the truss rods. This latter car has four rods, with a truss 20 inches deep below the sills. All castings of the car body and truck are of malleable iron. The feeding and watering troughs are of pressed steel. These cars were built about four years ago, and have proved to be good substantial cars of their kind, not having sagged or given way at any part of the framing. They weigh between 5,000 and 6,000 pounds less than most cars of the type, size and capacity, and are just as serviceable."

This is a practical application of Mr. Morris' policy of increasing net earnings by hauling a pound of paying freight for every pound of reduction in weight of car, and this was done before the tonnage question had become a live issue. The framing of Mr. Morris' stock car is shown in Fig. 1. It is also very light.

A reference was just made to malleable iron castings as one of the factors in reducing weight, and they always play an important part in the scheme of lowering the light weight of cars. The value of malleable iron in this special field is well told by Mr. Eugene Chamberlain, in his paper on "Malleable Iron in Car Construction," read before the Central Railway Club, in which he said:

"Now as to the question of dead weights: With a reduction of from 1,300 to 1,500 pounds per car of 60,000 pounds capacity, as compared with gray iron castings, we readily see that an extra car might be easily added to each train of 15 cars without placing any additional tax upon the motive power. Or, assuming that a railroad company is deriving a revenue for carrying 20,000 pounds of gray iron castings, could not this revenue in all fairness be credited to the original cast of malleable iron castings as the producing cause? This does not occur once a year or once a month only, but is in evidence every trip of the train, thus adding strength to the argument we seek to advance, and creating a revenue for the company from an apparently undiscovered source. If we take what statistics show it costs a railroad company per ton per mile to haul freight, and a car will average say twenty miles a day for a year, and there is a reduction in dead weight of 1,300 to 1,500 pounds per car on account of using malleable castings, a simple calculation with the foregoing figures as a basis, will readily demonstrate that the company is deriving a yearly revenue equal to one-half the original cost of the malleable castings used on the car. Add to this a reduction in the stock of castings necessary for a company to carry on account of less breakage of malleable iron as against grey iron castings, and we secure a sum total that would seem to recommend malleable iron castings for general use in car and locomotive construction and repairs."

The ratio of paying load to dead load in the case of the light wooden box car of the Chesapeake & Ohio is 2.4. This is probably as high as wooden construction will permit for box cars, but a slightly higher ratio (2.53) is found in the 80,000 pound wooden gondola cars of the Illinois Central, which is no doubt the limiting figure for wood. These cars weigh 31,500 pounds empty. Steel, however, presents means of raising the ratio of load capacity to dead weight, and we find such proportion on some 100,000 pound steel cars to be 3.8. These cars are for ore service, and are only 26 feet long, they therefore vaguely indicate what may be done in the design of the all steel box car which is yet to come. There are, however, sufficient data to be gathered from the steel cars already built to show the advantages of that construction, in reducing the number of cars to the train, and therefore the resistance on curves, as well as increasing the tonnage per car, all of which results

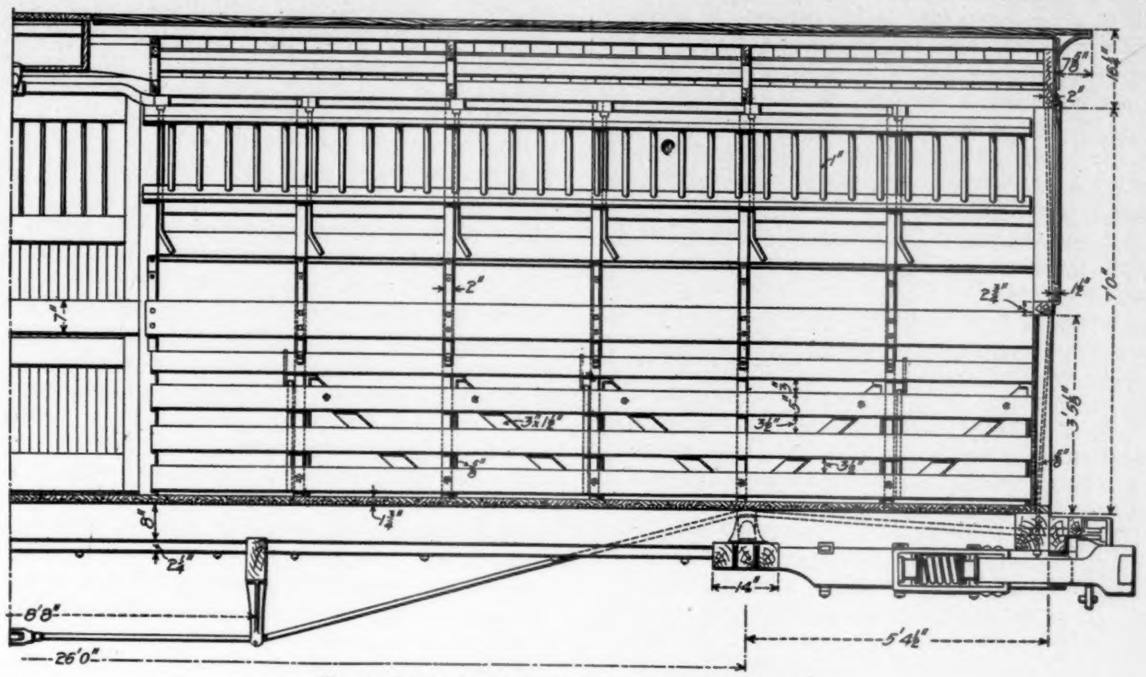


Fig. 1.—Light Stock Car—Chesapeake & Ohio Ry.

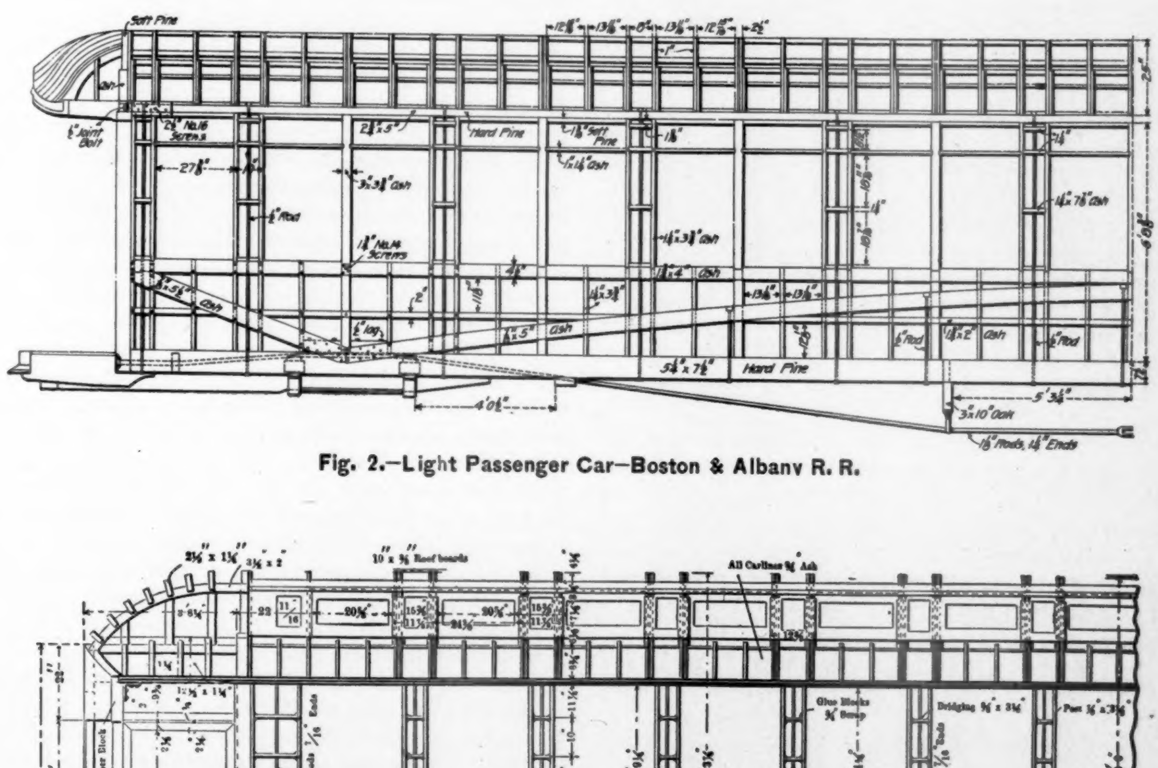


Fig. 2.—Light Passenger Car—Boston & Albany R. R.

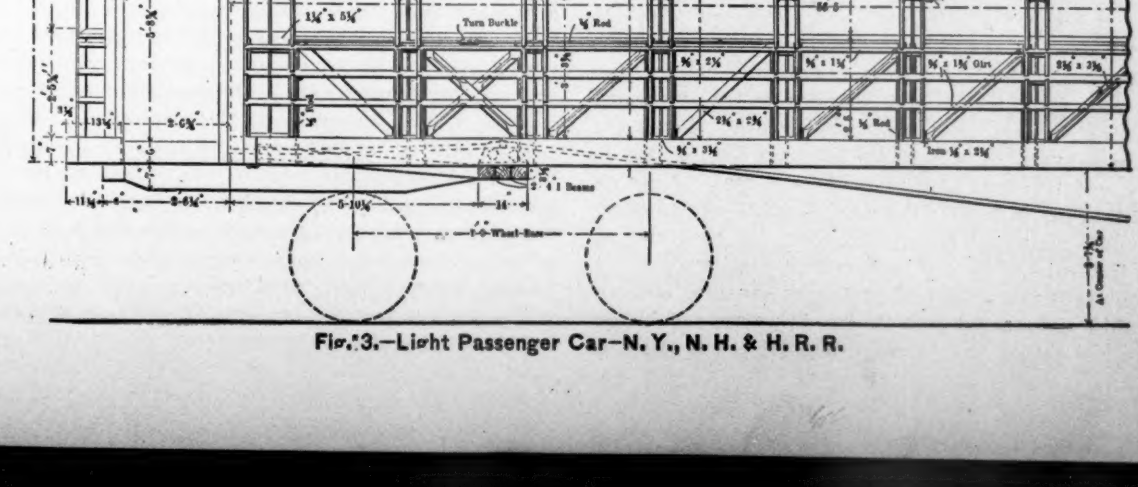


Fig. 3.—Light Passenger Car—N. Y., N. H. & H. R. R.

are desirable to attain when considering economy in transportation. That these advantages are not chimerical is now well known, that they are not obtained at a prohibitive cost may be seen by a comparison of the cost per ton of capacity for the wooden 60,000 pound car and the steel 100,000 pound car. The cost of the former will be not far from $500, and of the latter about $800. Assuming these prices to be correct, the cost per ton of capacity will be practically $16 for each car, and here is to be found the reason for the recent large orders for large capacity steel cars.

The interest awakened in the large car in this country has led to some investigation of its status if pitted against foreign cars in the same service, which resulted in a comparison of two coal trains—one English and one American, by Vice-President Joseph Price, of the Grand Trunk. The English train was made up of 57 coal cars, having a total weight of 852 tons, and the American train had 24 gondolas, the loaded weight of which was 919 tons. The paying load per cent of the English train was 51.71, and of the American, 61.11. The English train had 130 axles and the American 109. This comparison shows the large capacity of the American cars to be advantageous, but occasion was taken to explain that the conditions in England were such as preclude the possibility of following American practice, owing to certain restrictions in tunnel dimensions and turntables.

Passenger Cars.

It is worthy of comment, that while there is such a well defined recognition at this time of the necessity of a high percentage of capacity to light weight in a freight car, the proportion of weight hauled per unit of paying load in a passenger car is neglected, as the rivalry of competing lines is a constant incentive to furnish better and roomier accommodations, with retiring rooms, vestibules and other luxuries unknown in the older equipment. Some first-class coaches of to-day will average 65,000 pounds in weight, and seat 60 people, which means a dead weight of 1,000 pounds to be hauled for each passenger when the car is filled. The coach of only a few years ago weighed 38,000 pounds and seated the same number of passengers as above, with 630 pounds of car per passenger. The initial cost of these later cars also helps to swell the loss side of the account, for they cost from $6,000 to $8,000 as against $3,500 to $4,500 for the car with the fewer palatial bids for patronage.

The acme of extravagance is reserved, however, for the sleeping car service, where the gap between first cost and seating capacity widens to an unbusinesslike degree. The cost for the least magnificent of these is from $15,000 to $20,000, and runs into a higher figure for the more pretentious creations. The average weight of these cars is about 95,000 pounds, and the seating capacity is 24 people for a twelve section car. The load necessary to carry one passenger is about 4,000 pounds in this case, but a worse situation presents itself when it is stated that some of these cars are seldom loaded to their full capacity.

In direct harmony with these heavy American cars is the English sleeping car with a seating capacity of 16 passengers and a weight of 50,000 pounds, which gives a ratio of dead weight to passenger a little lower than that of our sleeping car, the cost, however, is quite different, averaging $6,000 to $7,000, or the price of our first-class coach. These figures it must be understood refer to the English design of sleeper, and not to the American, which is in service on some foreign lines. The English composite car, carrying first, second and third-class passengers, of which we have no counterpart in this country, weighs about 42,000 pounds, and seats 33 people. The cost of this car is $4,000; the dead weight per passenger is 1,200 pounds, somewhat more than ours, for a service no better than is furnished by our best modern coaches.

Since about 1870 the weight of passenger cars has steadily increased, while the seating capacity has to an appreciable extent become less rather than greater, against the protests of the officers responsible for their design. Vestibules and end corridors, the latter separated by bulkheads from the seating room of the coach, together with heavier framing, all contributed to greater weight without any returns in capacity. A letter from Mr. F. D. Adams, the veteran Master Car Builder of the Boston & Albany, on this subject of passenger car construction, contains some interesting points. Mr. Adams writes:

"I used to feel much interested in this matter (light construction), as I believe that railway companies haul much more dead weight in their passenger equipment than is necessary to the passengers carried. The tendency of late years has been to have in mind the strengthening of cars, and to do this large amounts of iron and heavier timbers have been used instead of trying to get strength with least weight. One car in particular was built at Allston shops about twenty years ago, and is now in service, in good condition. It weighed when placed in service, only 36,000 pounds, and seated 76 passengers. This car has been in continuous service ever since, and looks in as good shape as cars that weigh 20,000 pounds more. The material was cut down everywhere possible. The sills were 4x7 inches; the window posts only ⅞x3¼ inches; floor was double ⅞-inch thick, and lining under; roof boards were ⅝ inch thick; panelling outside and inside only ⅜ inch thick, but was thoroughly glued with strong glue with canvas all over inside; carlins ⅞ inch thick strengthened with iron every 6 feet. The furring between window posts was cross-braced, locked together and only ⅜ inch thick, but all was carefully fitted and glued, the workmanship carefully done, and the result shows for itself. This car has done as much service as any other, being run in regular trains without favor, and is still good for many years yet. I supported my cars differently from any one else, by using an arch under the window rail, stepped into the sill on each side or rather both sides of the window posts, with rods from the arch down through the sill, and putting a saddle at top of the arch for the rod to pass through between them. The outside one was carefully fitted into the post and glued and screwed. The arches were ⅞x5 inches, and the inside one glued and screwed to the post also, and the inside lining was fitted snug to it. This arch took the place of the heavy truss plank usually used, and did not weigh more than one-eighth as much, while sustaining more weight. There is one thing I will admit in connection with light cars, they cannot be made to ride as easy as heavier cars."

This is a valuable contribution to the literature of light cars from an eminent authority, and it carries an important moral in the fact that passenger coaches may be built with a dead weight of 470 pounds per passenger, and still stand up under the ravages of 20 years' service.

Through the courtesy of Mr. Thomas B. Purves, Jr., Superintendent of Rolling Stock of the Boston & Albany, we illustrate in Fig. 2 the framing of their standard coach. Referring to the light car built by Mr. Adams, and his present standard, Mr. Purves says: "Coach 44 (the car described by Mr. Adams) was built in 1897, and is the lightest car we have. The weight of the body of the car is 23,970 pounds, and trucks 12,020 pounds; making a total weight of 35,990 pounds. This car has a seating capacity of 76 passengers. I regret very much that we have no blue prints or drawings of this car. I send you blue prints of our standard passenger car; the weight of body of this car is 34,100 pounds, and weight of trucks 19,380 pounds, a total weight of 53,480 pounds."

This car has a seating capacity of 78 passengers, which means the respectable ratio of 685 pounds of car to one passenger, and while somewhat heavier than car No. 44, it makes a showing decidedly favorable to its designers at a period when the tendency is to increase weight. The framing carries its own lesson without comment.

A strictly modern car embracing every known expedient to reduce weight, and at the same time retain all of the outward

points of the standard car of the road, is seen in Fig. 3, which illustrates the framing of the light car built by the New York, New Haven & Hartford. It shows one of the latest revivals of interest in light cars, and without doubt exemplifies very nearly the limit at which framing can be cut in dimensions with our present construction. This car is 56 feet 5 inches long and 9 feet 6 inches wide over sills. It has vestibules and is fitted with all equipments familiar to the best practice, but weighs only 51,750 pounds, which is nearly 8,000 pounds less than the other cars of the same size on the road, and gives 690 pounds of car per passenger. Attention is directed to the details of this car; they will be found interesting enough to dwell upon. The roofing is ⅜ inch thick; all carlins are ¾ inch thick; side posts are ⅞x3½ inches; belt rail 1¼ inches thick; sheathing ⅜ inch; flooring ½ inch for lower course, and ¾ inch for upper; sills, center and outside, 4¼x7¾ inches, two intermediate, 3x7¾ inches.

The overhang is supported by a truss passing over the braces and under the belt rail, with the ends passing through the sills at each side of the body bolster, the lifting effect being produced by the turnbuckle shown. This car was built in the fall of 1896. It was designed by Mr. E. E. Pratt, one of our veteran Master Car Builders, but who is now Superintendent of Buildings of the above road, and built by Mr. Appleyard, Master Car Builder of the N. Y., N. H. & H. at the New Haven shops. Mr. Pratt, while at the head of the New England car department, was for years an ardent advocate of light construction, and does not think that a car must necessarily be heavy in order to ride smoothly, as the following extracts from his letter referring to the light car of the New Haven road will show; in this connection he writes:

"This car is running now in the five-hour trains between New York and Boston, via the Air Line Route, and has been in that service ever since it was built. As that is one of the most important trains and largely patronized, it would seem that it has given entire satisfaction or it would not have been kept in that service. I believe that it is feasible to have light weight cars, and that they can be made as comfortable riding as any car in existence. The car can be lightened up a good deal, as the effort in that case was entirely confined to the body of the car. Twelve years ago I built a light weight car and constructed the trucks on the light principle. The trucks when complete weighed 16,000 pounds, while the trucks under this car (the New Haven) were of the standard pattern of trucks, which we put under the parlor cars of this road, and weigh something like 21,000 pounds. The 16,000 pound trucks have now been in service twelve years, and are still in fine condition, while the repairs on them have been very light in comparison with the trucks of ordinary build."

The Manhattan Elevated cars of about 1880 furnish another example of light construction that must not be passed unnoticed. These cars were constructed for a service where light weight was of prime consideration. The length inside is 38 feet 6 inches, and the weight about 30,000 pounds, while the seating capacity is 48 passengers. The ratio of dead load to passenger is about 625 pounds for the rated capacity of the car, which is more than doubled during the rush hours.

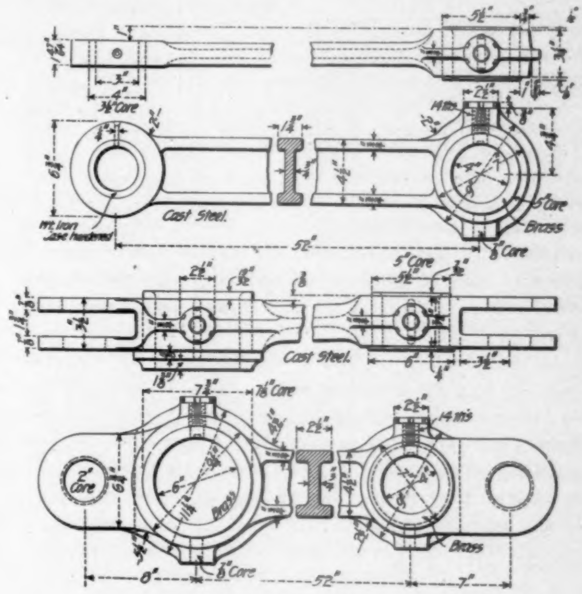
If further confirmation were necessary to show that the net revenue of railways was made to languish by the heavy car fad, it will we believe, be forthcoming in the not very remote future, when the rapidly closing avenues for retrenchment in operating expenses will force a reduction of weight to a reasonable and paying ratio of load hauled.

The use of electro magnets is proposed for the recovery of a large number of steel rails which were sunk in the Ohio River. The "Electrical World" states that a crane boat will be equipped with waterproof magnets capable of lifting 4,000 pounds each. The work will be done by the Langton Electric Company, Pittsburg, Pa.

CAST STEEL SIDE RODS.

Philadelphia & Reading Railway.

The illustration of side rods herewith, represents the practice of the Philadelphia & Reading, as applied to consolidation engines, and is printed by courtesy of Mr. E. E. Davis, Assistant Superintendent of Motive Power and Rolling Equipment. Evidence of careful thought is seen in this design, particularly in the ribbing over the ends, a place where a combination of strength and lightness is required as much as in any part of the rod, for the reason that a very light section may be made here, and one that will successfully resist all piston stresses, but at the same time the bushing may get loose. The rib should prevent this action while still preserving a proper degree of lightness at the end. There are now



Cast Steel Side Rods.
Philadelphia & Reading Ry.

50 sets of these rods in service, and they are so satisfactory that all consolidation locomotives on the road are to be fitted with them.

A comparison of the cost of these with wrought iron rods for the same class of engine shows the steel rods to be somewhat higher than wrought iron by the figures furnished by Mr. Davis.

Cast Steel.

Full set of cast steel rods, finished, weight, 820 pounds.
Cost of labor, finishing rods............................$12.30
Total cost of rods without brasses.................... 80.30

Wrought Iron.

Full set of wrought iron rods, finished, 810 pounds.
Cost of labor, finishing rods............................$19.58
Total cost of rods without brasses.................... 72.31

The cost of labor for the steel is less, and the difference in the total cost is therefore to be ascribed to the present high price of the steel, which was due in part to rigid specifications. The specifications for this material called for tensile strength between 60,000 and 75,000 lbs. per square inch; and the elongation 30 per cent. for 60,000 lbs. tensile strength and 24 per cent. for 75,000 lbs.

We have no record of the tests on the heats used by the Sargent Company for the rods which they have furnished to this road, but the following table of limits represents the chemical constituents of the metal regularly produced for general steel castings:

	Per cent.		Per cent.
Silicon	0.30 to 0.40	Sulphur	0.02 to 0.04
Carbon	0.25 to 0.30	Phosphorus	0.025 to 0.035
Manganese	0.70 to 0.90		

The metal furnished the Philadelphia and Reading is the same as that furnished to the Chicago and Northwestern, the test record of which is as follows:

Steel Castings for the C. & N. W. Ry.

Date.	—Original.— Dimension.	Area.	—After fracture.— Dimension.	Area.	Tensile strength per sq. in.
Jan. 5, 1899	1.0000	.7854	.740	.430	69,300
Feb. 4, 1899	.9850	.7620	.755	.4477	62,508
Feb. 14, 1899	1.0000	.7854	.710	.3959	62,906
Feb. 22, 1899	1.0000	.7854	.761	.4548	66,068

Elongation. In 8 in.	Per Cent.	Reduction of Area %.	Elongation. In 8 in.	Per Cent.	Reduction of Area %.
1.94	24.25	45.22	2.28	28.50	49.59
2.05	25.62	42.33	2.02	25.25	42.09

In this connection the record of seven tests on material furnished to the United States Government, the last two of which were made at St. Paul by the Government Inspector, are interesting:

Steel Castings for the United States Government.

Shoulders 3 inches.

Date.	Tensile Strength Per Sq. In.	Elongation Per Cent. in 2 inches.	Reduction of Area %.
Feb. 15, '99	62,750	32.	50.0
Feb. 16, '99	66,500	31.	48.5
Feb. 17, '99	68,900	31.	39.3
Feb. 22, '99	67,650	30.	45.75
Feb. 28, '99	70,000	29.	42.4
Feb. 3, '99	70,250	35.	45.
Feb. 6, '99	69,850	32.5	46.

With a reduction of the price of the castings, the steel rods will be cheaper than those of iron. There appears to be no good reason why the cast steel rods should not be used when experience in casting permits of reducing the cost to that of producing other similar steel castings. This case may be considered as experimental. It is too early to express opinions as to the practice beyond a statement of the satisfaction which has led to their adoption in this case. It seems advisable, however, that caution should be exercised in the reduction of machine work on steel castings of such importance, because of the possibility of defects in the castings, which are to be found only by machining, and it is proper to raise the question whether the amount of machining may safely be reduced until such time as steel makers are more sure of their product.

At the March meeting of the Central Railroad Club a committee on car roofs, consisting of Messrs. Waitt, Macbeth and Mackenzie, presented a report that reviewed everything in the semblance of a roof cover, from the single and double board to and through the various types of composite metal and wood roofs. After stating the prerequisites of a perfect roof, the committee gave it as their opinion that the best type of car roof, that is, the one most fully meeting the qualifications named, is one having a complete metal protective roof for excluding moisture, cinders and dust. This metal roof, being composed of short sheets of galvanized iron, extending from plate to ridge pole, and so applied that they can be removed without having to remove the outer roof boards. This metal to have laid over it, with an air space between, a single course of matched boards. The whole to be thoroughly secured together and to the car by bolts and long wood screws. In addition to this, it was recommended that a course of sheathing be laid on the under side of the ceiling lengthwise of the car as a protection against punctures of the metal sheets when loading and unloading freight. The cost of such sheathing would amount to not over $8 per car and would save many times that amount in repairs and claims for damages to freight.

There are 55 war vessels contracted for or now building for the United States Navy, according to the report of Admiral Hichborn, Chief Naval Constructor. The following are the proportions completed:

Ship.	Builders.	Conditions. Per Cent.
Kearsage	Newport News	85
Kentucky	"	83
Illinois	"	62
Alabama	Cramps	76
Wisconsin	Union Iron Works	63

COMMUNICATIONS.

RAILROADS AND THE CAR COMBINATION.

Editor "American Engineer:"

I am overwhelmed with letters based on a statement that the New York "Herald" of the 14th represented this company as being dissatisfied with the Car Trust, so-called.

I desire to say that it is my point of view that the legitimate business of a railway company is transportation, and the nearer it sticks to its legitimate business the better for it.

I know of no reason why the trust cannot manufacture at as low a cost as the constituent companies have manufactured, and until there is some evidence that the trust intends to exact exorbitant profits, I can see no reason for railway companies even considering the problem of manufacturing cars. Therefore you may say that the Chicago Great Western Company has no intention whatever of entering into the business of manufacturing cars.

A. B. STICKNEY,
President Chicago Great Western Ry.

St. Paul, Minn., March 18, 1899.

THE RESISTANCE OR LAGGING OF LOCOMOTIVE VALVES

Editor American Engineer:

In the March number of the American Engineer the opinion is expressed by yourself and Mr. Henderson that the designed port openings in locomotives are not obtained, even when piston valves are used, owing to the springing of the gears.

It seems to me that if this were true to any appreciable extent, the engines would be rendered inoperative at short cut-offs. In a large proportion of locomotives not more than ¼ or ⅜ inch openings are obtained in the earlier cut-offs, and a very little lost motion and springing of the valve would wipe this out altogether. Old engines with unbalanced slide valves could not be made to run under such conditions.

Now, as practice never upsets correct theory, it is evident that Mr. Henderson and yourself have overlooked a very important factor in the correct understanding of valve motions, viz., the inertia of the valve. As the deceleration of the valve is greatest during the last quarter of its stroke, during which the port opening is effected, it is evident that all elasticity and lost motion of the gear is taken up and added to the stroke of the valve, thereby increasing instead of diminishing the port openings. This is, of course, especially true of piston and balanced slide valves operated at high speeds.

W. F. CLEVELAND.

Philadelphia, March 3, 1899.

[Our correspondent would be right in his view of the effect of inertia of valves, if they were perfectly balanced, and our criticism was directed to the valves that are not perfectly balanced and to those of the piston type which are so made as to permit steam pressure to set the packing strips out against the casing. Piston valves are now in use which are so made, and are little better than balanced slide valves because of this trouble with the packing. Returing to slide valves, we would remind our correspondent of the tests on large and small valves on the Chicago & Northwestern, reported on page 356 of our issue of October, 1897; also the experience on the same road recorded in the Proceedings of the Western Railway Club, September, 1896, page 21, and April, 1897, page 377.—Editor.]

FEED WATER HEATERS FOR LOCOMOTIVES.

Editor American Engineer:

I have always believed that it would pay to try to use feed water heaters on locomotives, and I cannot see any insurmountable mechanical difficulties in the way. The idea is not at all new, and the articles on pages 20 and 27 of your January issue reminded me of a heater that the late Mr. W. S. Hudson, of the Rogers Locomotive Works, designed in 1859, and fitted to a number of engines for the Southern Railroad of Chili. It consisted of a cylinder, about 16 inches in diameter and perhaps six feet long, carried back of the cylinder saddle and

between the frames. The feed water passed through the cylinder from one end to the other, and came into contact with a number of tubes through which steam from the exhaust pipe was led and was afterward returned to the front end and directed up the stack. This heater was used for some time, and I do not know why it was abandoned, but probably because, with the comparatively small demands made on the boilers of that day, the need of feed heating was not felt, and it was difficult to measure the advantage of such devices at that time.

I agree with Mr. Francis W. Dean in the opinion he expressed in his excellent paper on boilers, read in December before the New England Railroad Club. Mr. Dean said that the great possibility of heating the feed water by the exhaust steam from the locomotive frequently occurs to engineers, and, although it is not received with much patience, it ought to be studied out to success. "It takes only about one-sixth of the steam from the exhaust to raise the temperature of the feed water from fifty degrees to two hundred degrees, and this would save about fifteen per cent. of the fuel. As the locomotives in this country use about one-third of the coal mined, or over fifty millions of tons per year, this means an enormous saving in money. I am glad to see that one of the railroad clubs has been discussing the best use of the exhaust of the air pump. This might be used for heating the feed. If the feed can be heated it will necessitate the use of pumps instead of injectors, and, moreover, pumps driven by the main engine, instead of steam pumps, for the use of the latter gives more exhaust to deal with."

A. E.

DISCIPLINE AND EDUCATION OF RAILWAY EMPLOYEES.

Editor "American Engineer:"

Thus far the discussion in your pages on the question of discipline has brought out only one adverse opinion, that signed "Master Mechanic" on page 83 of the March number, and I would like to know the opinions of some of the real good railroad men who are opposed to the plan. There are many such, and they have some excellent reasons for objecting to the system which, I hope, will be brought forward now.

I think well of the idea of the system inaugurated by Mr. Brown, but think that the opinions expressed in your paper are entirely too favorable. In order to use the system satisfactorily, the greatest care must be used in its administration and it cannot be allowed to take care of itself as I believe many think it will do. It requires even more of the personal attention of the officers than the old plan of suspension. I do not believe I am wrong in thinking that the importance of this is not generally realized.

The debit and credit system, when looked at in one way, appears to be the fairest method of dealing with the faults and merits of men, but is it not very unfair to the younger men. The old and seasoned engineers, for example, very seldom get into trouble, and this is not entirely due to their reliability, but rather to a large extent to the fact that they have the best runs, where they are associated with the best crews and the most favorable conditions for satisfactory service. Not so with the younger men who are given the vastly more difficult work of handling the extras and way freights. It is easy to handle passenger trains and fast through freight, where the entire crews are selected for their good records as compared with the extra running and the handling of the trains that are not taken care of by the dispatchers and officers. A young man running extra has to put up with the worst of the crews and in my opinion he does not find the system so satisfactory. Also the young men who are running "extra" do not find the suspension so burdensome because they expect to "lay off" once in a while anyway, because of the fluctuations in business. Now, I submit that it is better for these men to be able to "clear up" their records by suspension, after getting into trouble, than to hold the record against them as long as they are on the road. While they may be judged to be to blame, it is true that their surroundings are often contributary and I think with "Master Mechanic," that the new plan discourages them and prevents them from doing their best work to put themselves on their feet again.

Another fault with the Brown system, and it is a serious one, is that when a crew desires to be relieved from association with a certain member, say a conductor or engineer, they can avail themselves of the opportunity to "snuff him out" after he has received nearly enough demerit marks to cause his dismissal. If a man has, say, 50 out of the 60 marks that would cause his discharge, the rest of the crew can easily report enough little things to secure the other 10 marks and get rid of the man without his being able to defend himself, and when he is not to blame.

There are other objections, and perhaps some that are more important than these, and, in fairness, they ought to be brought out and removed if possible because there is a great deal that is good in the system.

SUPT.

THE M. C. B. COUPLER ABROAD.

Editor "American Engineer:"

Since writing the communication on "The M. C. B. Coupler Abroad," printed in your February number (page 44), I have frequently heard the question asked, whether or not the vertical plane coupler, in its present form, as used in this country, is applicable to the European type of freight cars. As a matter of information, I would like to state that the Nesseldorf Car Manufacturing Company, of the city of the same name, has recently, in co-operation with a large American car coupler company, brought out a draft rigging for that purpose, which is reported to be quite satisfactory. This is mentioned because it is one of the first designs in that line, showing that the idea is practical, and it will no doubt be followed by others suitable to the various makes and dimensions of cars.

The railroad men generally in Continental Europe have become familiar with most types of M. C. B. couplers used in this country, through visits here as well as through working models sent from here for that purpose. Information is also at hand to the effect that a test is at present being made on the Stramberg-Wendorf line with American couplers, and that a number of railroad men from Germany and other European countries have visited Stramberg during the last two or three months for the purpose of noting the performance of the couplers.

EDW. GRAFSTROM,
P. C. C. & St. L. Ry.

Columbus, O., March 13, 1899.

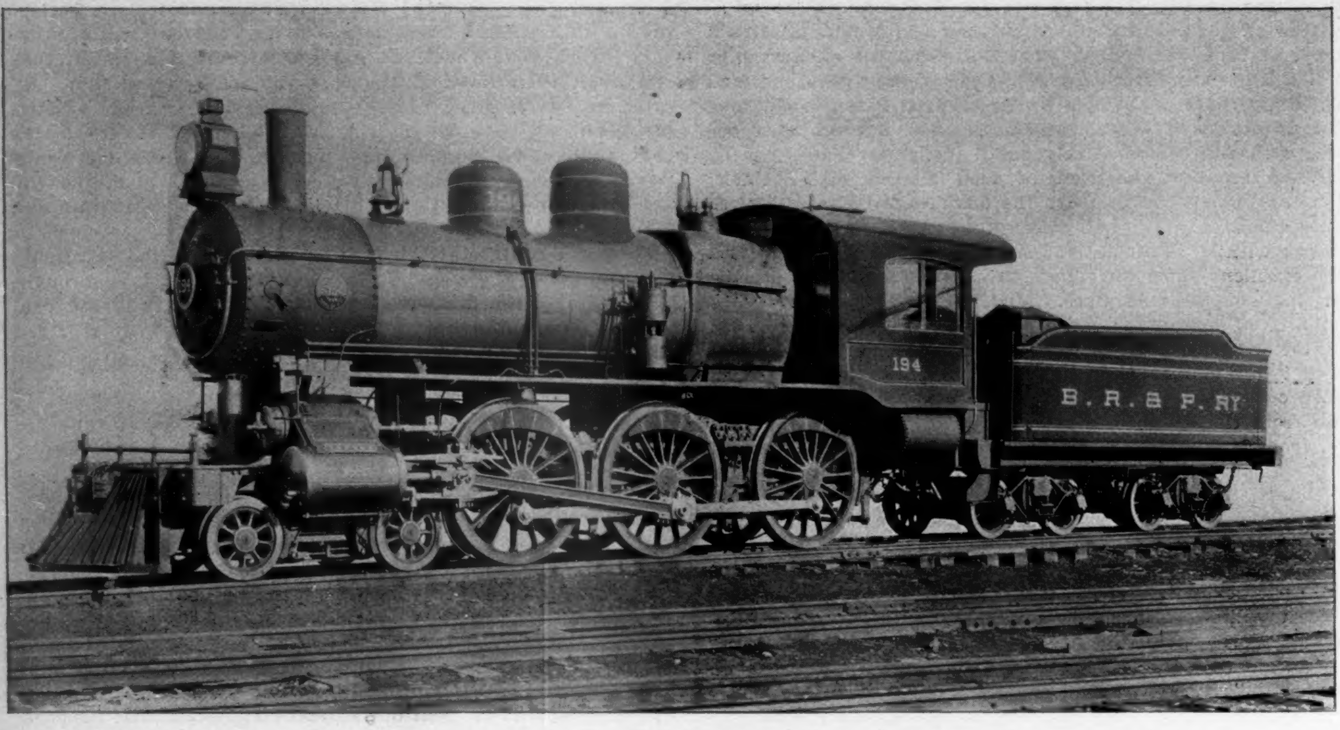
RAILROAD EARNINGS IN 1898.

The preliminary report of the income account of railways in the United States for the year ended June 30, 1898, reported to the Interstate Commerce Commission, has been issued. The report includes the returns of 720 lines, with an aggregate mileage of 181,333 miles. The receipts of the year were: Passenger service, $333,892,782; freight service, $874,865,487; other earnings from operation, $30,765,111; gross earnings, $1,238,523,-380; operating expenses, $811,241,458; income from operation, $427,281,922.

The increase of gross earnings over the previous year was $165,161,583. Operating expenses increased $58,716,594, and income, $57,716,913. Gross earnings per mile increased $708; operating expenses, $368; income, $340. These are the largest figures reported since 1892, and the income account shows an increase of $410 a mile over the report for 1894.

The total income of the railroads for the year 1897-98 was $466,790,116. Dividends were paid amounting to $65,995,515. Other deductions (interest on bonds, taxes, etc.), $358,189,202, leaves a surplus from operations of the year of $42,604,999. The corresponding item for the previous year showed a deficit from operations of $1,412,399. Statistician Adams adds:

"The amount of dividends stated does not include those declared upon the stock of lines operated under lease. This report is confined to operating roads. The amount of dividends declared for operating roads exceeds the amount of dividends declared for the previous year by $6,839,337. This fact, taken in connection with the increased surplus, suggests in another way the revival of prosperity for American railways."



Ten-Wheel Passenger Locomotive—Buffalo, Rochester & Pittsburgh Ry.
The Brooks Locomotive Works, Builders.

BROOKS TEN-WHEEL PASSENGER LOCOMOTIVE.

Buffalo, Rochester & Pittsburgh Railway.

The Brooks Locomotive Works have recently completed a lot of five ten-wheel passenger locomotives for the B., R. & P. Ry., which are represented by the accompanying illustration. These locomotives are of the simple type, with piston valves 10 inches in diameter and cylinders 18x26 inches. The valves are somewhat reduced in diameter from former sizes, and the valve stems are fitted with knuckle joints; the latter feature is an important return to old practice, for many still believe the old flexible connection between the valve rod and valve stem to be preferable in every respect to the later rigid form of connection, even if there is an extra joint to keep tight and free from lost motion.

The smokebox is Mr. J. Snowden Bell's patent short-form, with his spark arrester, its use in this design being another indication of the increasing popularity of short smoke boxes. The use of piston valves permits of a favorable location of the links and a good link radius. The valve stems are in line with the frames and directly over their centers, and it was not necessary to locate the rocker boxes with a view of getting them into a narrow space between the wheels. In this case the rocker boxes are placed below the upper bars of the frame and inside of the forward driving wheels. Both top and bottom rocker arms are inside of the frames and upon the inside end of the rocker shaft. The valve motion in this case is admirably direct. The lower rocker arms are connected directly to the link blocks, without the lever and hanger complications that are often used when the rocker shaft must come out between the driving wheels. This arrangement is as simple as that of an eight-wheel engine.

There is evidence of some attention to strength in the crankpins, as calculation shows a fiber stress of 15,400 pounds per square inch on the main pins at the hub, under a bending moment due to boiler pressure, and assuming one pin to resist the whole force. This is an exceedingly favorable fiber stress, and the pins must be considered as safely designed, and they will probably give a good account of themselves. A departure in the arrangement of the front driving spring from former practice of these builders will be noted. This spring now passes under the frame directly to the top of the driving box, dispensing entirely with the saddle. This effort to simplify design and reduce the number of pieces is commendable, but it is open to question whether springs should have rubbing contacts at their ends.

These engines will exert a starting effort of 22,000 pounds under very unfavorable rail conditions and without sand, having a weight of 108,000 pounds on drivers, which gives a ratio of tractive power to adhesive weight of 0.2.

Among the other features of the design we note the Player. Belpaire boiler, brakes on the truck wheels, the location of the driving brake cylinder under the boiler and immediately back of the forward axle. The top of the cylinder may be seen over the top of the forward driving wheel in the photograph. The brake shoes are behind the driving wheels. At the cylinders the frames widen into slabs 9½ inches deep by 4 inches wide. The leading dimensions of the design are given in the following table:

Ten-Wheel Passenger Locomotive.

Gauge	4 ft. 8½ in.
Kind of fuel	Bituminous coal
Weight on drivers	108,000 lbs.
" " trucks	34,000 "
" total	142,000 "
" tender loaded	98,000 "
General Dimensions.	
Wheel base, total of engine	24 ft. 3 in.
" " driving	14 ft.
" " total, engine and tender	51 ft. 10¾ in.
Length over all, engine	37 ft. 2⅜ in.
" " " total, engine and tender	61 ft. 5⅜ in.
Height, center of boiler above rails	9 ft. 1 in.
" of stack above rails	14 ft. 11½ in.
Heating surface, firebox	166 sq. ft.
" " tubes	1,862 "
" " total	2,028 "
Grate area	30.6 "
Wheels and Journals.	
Drivers, diameter	69 in.
" material of centers	Cast steel
Truck wheels, diameter	30½ in.
Journals, driving axle	8½ in. x 10 in.
" truck	5½ in. x 10 in.
Main crank pin, size	6 in. x 5½ in.
Cylinders.	
Cylinders, diameter	18 in.
Piston, stroke	26 in.
Piston rod, diameter	3½ in.
Main rod, length center to center	116 in.
Steam ports, length	21 in.
" " width	2 in.
Exhaust ports, least area	50 sq. in.
Bridge, width	3¼ in.
Valves.	
Valves, kind of	Improved piston
" greatest travel	7 in.
" steam lap (inside)	1⅛ in.
" exhaust lap or clearance (outside)	⅛ in.
Lead in full gear (negative)	1-16 in.

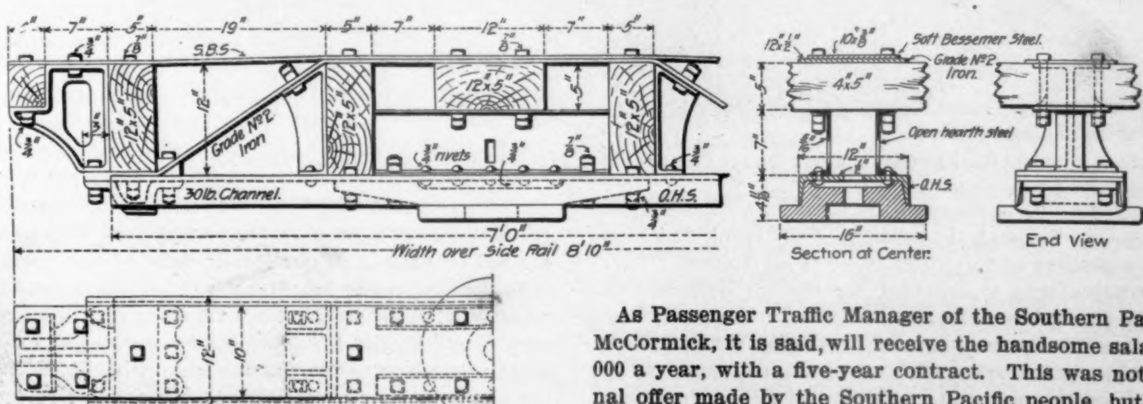
Boiler.	
Boiler, type of	Player improved Belpaire
" working steam pressure	200 lbs.
" thickness of material in barrel	5/8 in.
" " " tube sheet	3/4 in.
" diameter of barrel	62 in.
Crown sheet, stayed with	Direct stays
Dome, diameter	30 in.
Firebox.	
Firebox, type	Long, over frames
" length	108 in.
" width	42 in.
" depth, front	75 in.
" " back	60 in.
" thickness of sheets	Crown, 3/8 in.; tube, 5/8 in.; side and back, 3/8 in.
" brick arch	On studs
" mud ring width	Back, 3½ in.; sides, 3½ in.; front, 4 in.
" water space at top	Back, 4½ in.; sides, 6 in.; front, 4 in.
Tubes, number of	272
" outside diameter	3 in.
" length over tube sheets	13 ft. 2¼ in.
Smoke Box.	
Smoke box, diameter, outside	65 in.
" " length from flue sheet	61 in.
Tender.	
Tank, capacity for water	4,500 gals.
" " " coal	10 tons
Type of under frame	Steel channel
" " springs	Double elliptic
Diameter of wheels	33½ in.
" and length of journals	4¼ in. x 8 in.
Length of tender over bumper beams	22 ft. 1½ in.
" " tank	19 ft. 6 in.
Width of tank	9 ft. 10 in.
Height of tank, not including collar	46 in.

BODY BOLSTERS FOR TENDERS.

Northern Pacific Railway.

The general substitution of metal for wood in bolster construction is marked not only in new car work, but also in the newer tender designs for either metal or wooden frames. In the accompanying engravings a metal bolster is shown adapted to a wooden frame of the type long representing the practice of the Northern Pacific, but which were equipped with wooden bolsters up to the time the subject of the illustration was devised. It is of a very simple character, made up of a 12-inch, 30-pound steel channel for a lower member and foundation for the center plate, and a ½ by 12-inch tension member of iron, which passes over the center sills and joins the channels at the bottom of the outside sills.

On the top of the large channel, above the center plate, a pair of 7-inch steel channels extend from sill to sill and form a backing between the lower member of the bolster and the center longitudinal timber of the tender frame, thus giving sufficient rigidity at this point to overcome the reaction of the center plates. The center plates are of cast iron fitting in between the flanges of the channel with a bearing length of 34 inches, which also lends additional stiffness at the point where it is required.



Body Bolster for Tenders. Northern Pacific Railway.

Attention is directed to the security of fastening of the members at their junction at the ends. The upper piece after passing under the outside sills is bent on itself so as to form a foot which abuts against the web of the channel and continues out to take a bolt through the bracket supporting the outer rail of the frame. The bolt also passes through the outer flange of the side bearing, and a similar bolt passes through the inner flange and channel. One of the most important features of this bolster is wide range of adaptibility, as it is designed for and can be used on tenders of all classes of engines with wooden frames, old and new alike. We acknowledge the courtesy of Mr. Wm. Forsyth, Superintendent of Motive Power, for the drawing of this design.

THE AMERICAN CAR AND FOUNDRY CO.

The following is a statement of the car-building concerns which have united under the name of the American Car and Foundry Co., and their officers, as received from Mr. W. K. Bixby, President of the Company:

Michigan Peninsular Car Co., of Detroit.
Jackson & Woodin Mfg. Co., of Berwick, Pa.
Missouri Car and Foundry Co., of St. Louis, Mo.
Ohio Falls Car Co., of Jeffersonville, Ind.
Union Car Co., of Buffalo, N. Y.
St. Charles Car Co., of St. Charles, Mo.
Wells & French Co., Chicago, Ill.
Terre Haute Car and Mfg. Co., of Terre Haute, Ind.
Pennock Brothers, Minerva, O.

The officers are: Mr. W. K. Bixby, President; Mr. Fred H. Eaton, Vice-President and Acting Treasurer; Mr. W. J. McBride, General Auditor. The Secretary has not yet been elected.

Mr. Bixby's office is to be in New York, as are also the offices of the Treasurer and Auditor. Mr. William McMillin is chairman of the Board of Directors, and the Directors are as follows:

Mr. W. K. Bixby, Missouri Car and Foundry Co.; Mr. George Hargreaves, Michigan Peninsular Car Co.; Mr. J. L. Smyser, Ohio Falls Car Co.; Mr. Fred H. Eaton, Jackson & Woodin Mfg. Co.; J. J. Albright, Union Car Co.; Mr. Lewis J. Cox, Terre Haute Car and Mfg. Co.; Mr. H. B. Denker, St. Charles Car Co., and Mr. Charles T. Schoen, Pressed Steel Car Co.

The authorized stock of the American Car and Foundry Co. is $30,000,000 of 7 per cent. non-cumulative preferred stock and $30,000,000 of common stock, of which $2,400,000 of preferred and the same amount of common stock are to be retained in the treasury.

As Passenger Traffic Manager of the Southern Pacific, E. A. McCormick, it is said, will receive the handsome salary of $17,000 a year, with a five-year contract. This was not the original offer made by the Southern Pacific people, but they kept enlarging on that until the figures reached a point where it was too tempting to refuse, especially as President Ingalls, of the Big Four, advised its acceptance, the amount being greater than he could ever give Mr. McCormick. This is not Mr. McCormick's first flattering offer, but exceeds all others in the inducements offered.

Mr. John Player, who has been chief draftsman of the Brooks Locomotive Works for a number of years, has been promoted to the position of Mechanical Engineer.

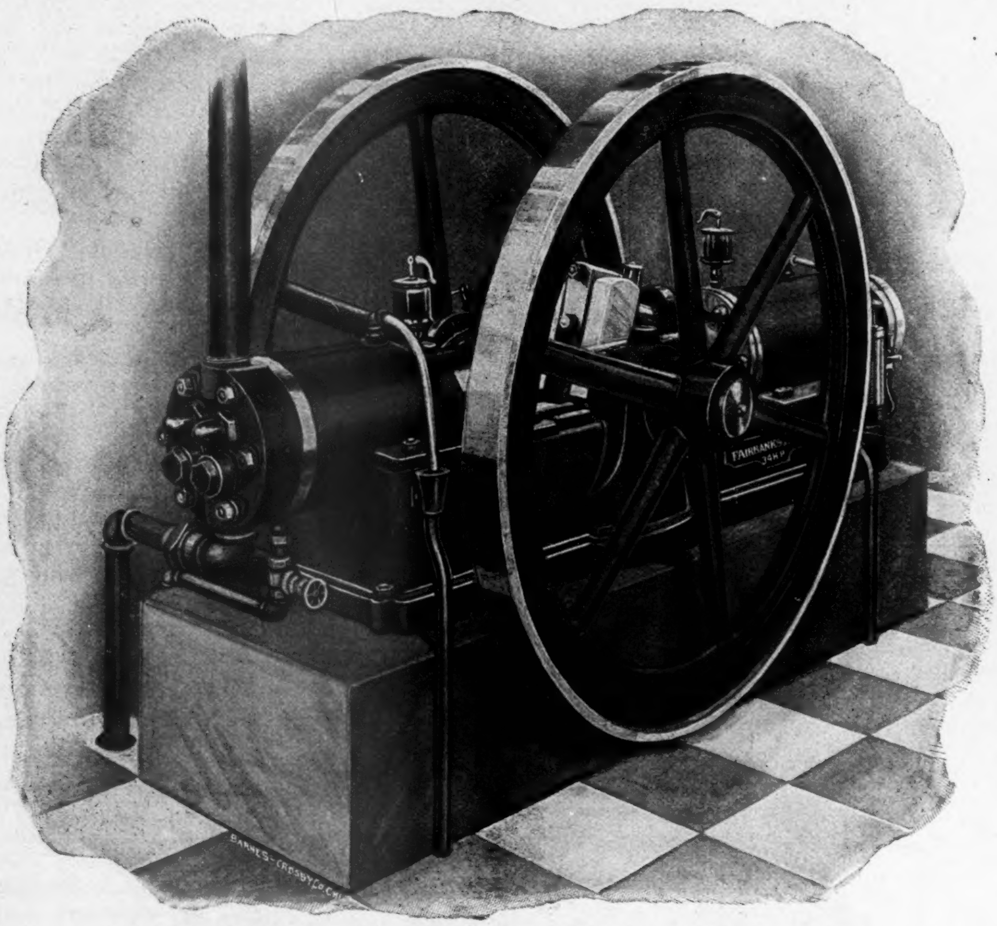
FAIRBANKS-MORSE DIRECT-CONNECTED AIR COMPRESSOR.

Using Gas, Gasoline and Distillate.

This machine fills a long felt want, both as a portable or field machine, and as a compact and simple stationary compressor. For ordinary shop work it has not been difficult to arrange either a steam or power driven air compressor to furnish air for the various requirements about the shop and factory, but when field work in general was considered the obstacles encountered were prohibitory for using any of the present forms of compressors.

This compressor is self contained; constructed with one bed plate carrying the two cylinders placed opposite, one on each side of the crank. The air piston is direct-connected to the power piston by distance rods. The crank shaft of the engine controls the length of stroke, and the speed of both the engine and compressor. Through the medium of the crank and heavy fly wheels, a positive and uniform speed is maintained. Large and ample valve area is provided for the air cylinder; the valves being made with removable seats easy of access, while the engine used is the well known Fairbanks-Morse gasoline engine. This combination permits of placing the engine in any desired location, either upon the work being constructed or near at hand. In bridge work it is customary to locate the compressor near the end of the bridge, as work is commenced, and, by a pipe line, air is conveyed to the bridge, where it is used for operating pneumatic riveters, drills and chipping tools. On the Illinois Central R. R. compressors are located in the middle of the bridges and on the swing spans of draw-bridges, the piping being carried both ways from the compressor. In the repairing or strengthening of old bridges, the compressor is frequently located on the bridge which is being altered. Little space is occupied, and it is not difficult to place one of these machines upon one side of the rails without interfering with traffic while the bridge is being altered. This compressor has also been mounted on trucks, making a complete, self contained, portable combination, which is very useful in ship yards, and one is now in use by the Cleveland Shipbuilding Company, at Lorain, Ohio, for riveting, drilling, reaming, chipping and caulking. It may be drawn about from place to place while running if necessary. Another has just been ordered for use in a large shipyard in Scotland.

This engine and compressor is useful for many purposes, such as the testing of air brakes, and the pumping of water by an "air lift." In case a terminal testing plant should be installed, the compressor, delivering air into a large receiver, would supply the air for testing brakes in yards where a large number of freight cars are daily handled, thus saving time and expense as well as delay, which would be necessary if the brakes were to be tested and charged by admitting air from the locomotive before the train was started. It could be used effectively in connection with a testing yard such as the one described on page 74 of our March issue.



Fairbanks-Morse Direct Connected Gasoline Engine and Air Compressor.

As the compressor is automatic in its action little attention is required after starting. The expense for fuel for operating is very small, as the governor admits either gas or gasoline in exact proportion to the amount of work applied. Therefore, if the amount of air used is small, the amount of fuel required will also be small, and as in either of the above cases the work is more or less intermittent, the saving would be large over any other known power. These compressors are built in several sizes, ranging from 70 to 360 cubic feet of free air per minute.

A number are already in use in railroad service. A representative of this journal recently inspected an installation at what is known as the "B O" signal tower at the west end of the Altoona yards of the Pennsylvania Railroad, where the compressor will be used to supply power for operating electro-pneumatic switch apparatus, besides furnishing air for charg-

ing and testing air brakes in the yard. Its chief recommendations for such service, besides economy, are the absence of fire and the small amount of attention required. As the engines regulate themselves, very little attention is required except to start and stop them and fill the lubricators.

A 12 horse power engine of this type is now in use on the bridge work of the Erie track elevation in Jersey City. It is mounted in a box car, and often runs four and five hours without any attention, the car doors being closed and locked except when the engine is started and stopped. On this work the compressor furnishes power for riveters made by the Chicago Pneumatic Tool Company, and its use rendered it possible to increase the amount of work from an average of 300 ⅝-inch and ⅞-inch rivets per day, by two men and two boys, to 1,200 ⅝-inch or 1,000 ⅞-inch rivets per day driven by one man and three boys, the work being now more satisfactory. This compressor furnishes 70 cubic feet of free air compressed to 80 pounds pressure per minute, at a cost of 12 cents per hour. We are informed that on a single ship recently built by the Detroit Dry Dock Company a saving of $2,700 was effected on the riveting of three decks by the use of a compressor and pneumatic riveters.

The Boston & Maine Railroad has installed a 12-horse power engine and compressor in a box car for use in cleaning bridges with the sand blast and also for painting them. The Canada Atlantic has recently ordered one and an unusual amount of interest is shown in them by railroad men. Lieut.-Col. Milton B. Adams, U. S. A., Engineer of the Eleventh Lighthouse District at Detroit, recently made a test of a 34 H. P. Fairbanks-Morse gasoline air compressor at the Beloit Works of the company and examined the machines for use in operating fog sirens and whistles. The report was very favorable, and the board was instructed to purchase two of them. The constant expense of keeping up steam pressure in the present equipment would be an important item in favor of gasoline engines in this service.

Our representative recently inspected one of these compressors in use at the new Appellate Court Building, Madison Square, New York. Jos. Smith & Co., who have the contract for the ornamental stone carving on the building, are using it to furnish air for seventeen sculptors who are using pneumatic tools. The compressor is running in a shed on a rough staging about 12 feet above the sidewalk. It has no foundation except that of the staging that was built to hold the ladders for the workmen, and it is working with only such attention as the man who puts up the stagings and assists the sculptors can give it. This means that it is merely oiled and looked at occasionally. This compressor furnishes air for seventeen tools using 4 cubic feet of free air per minute and uses city gas. At $1.10 per thousand it costs $1.60 per day to run these tools, and while we could not learn the amount of saving effected over hand work it is evident that the contractor is very happy to have the compressor, and this installation is a good example of the adaptability of the machine for rough and ready conditions. From these examinations of the machines, it is made apparent that they are to be very successful, and that a great many will be used.

We are informed that the Manhattan Elevated Railway, of New York, has just ordered a 12 horse power gasoline engine and compressor to be used on the elevated structure. Compactness and portability are important in such service.

Resumption of work on the Hudson River tunnel seems to be a reasonable possibility. The company is agitating the subject again, and a report is to be made upon it by Messrs. Sooysmith & Co. The East River tunnel of the New York & Long Island Railway Co. is also discussed again. It was started seven years ago and abandoned. The plan was to cross at Forty-second street. It is stated that attempts to raise capital are now being made.

NEW ENGLISH AND GERMAN PASSENGER LOCOMOTIVES

In England and on the Continent locomotive designers are making strong efforts to get away from the diminution lines that have been the prevailing characteristics of their locomotives, and are trying incidentally to increase the heating surface consistent with more powerful machines. To one who is abroad for the first time there are surprises in plenty when the attempt is made to compare the heavy passenger power with our own, for the reason that there is nothing over there directly comparable, and while this condition may continue for some time owing to many restrictions that are uncontrollable by the locomotive designer, improvements are under way that will be sure to do away with the light engines now so common on many lines.

One of the latest examples of the improvements for passenger service is the engine designed by Mr. H. A. Ivatt, Locomotive Superintendent of the Great Northern Railway of England. These engines have some points strikingly similar to our "Atlantic" type. They are four wheel connected with inside valve chests and outside cylinders, and also have trailing wheels. These engines have a 56-inch straight boiler with 140 square feet of heating surface in the firebox and a total of 1,302 square feet, with a grate area of 26.75 square feet. The cylinders are 19 by 24 inches, boiler pressure 175 pounds, and drivers 81 inches diameter. The weight of the engine is 130,000 pounds, the total of engine and tender is 220,000 pounds, and weight on drivers 69,440 pounds. These figures indicate the sentiment now stirring the English roads to cope with the increased weight of their passenger trains.

Some new engines built at Munich for the Westphalian lines, very closely follow the above in general proportion, having cylinders 19.25 by 23⅝ inches, and drivers 78.25 inches diameter. The total heating surface is 1,848 square feet, and grate area 30.25 square feet. The diameter of the boiler is 57 inches, designed for 191 pounds steam pressure. The weight is 128,970 pounds; weight on drivers 66,140 pounds, and weight of engine and tender loaded is 216,000 pounds. This engine is also four wheel connected and has a pair of trailing wheels, but has inside cylinders. The German engine, like the English one, was designed for having fast passenger service under the most trying conditions of grade and curves, and ranks in that respect as a decided advance over the older types of locomotives. A comparison of the starting power of these engines shows the English design to be able to exert a pull of 16,800 pounds, while the corresponding power of the German engine is 18,200 pounds, but the former engine, owing to the adhesive weight, will be able, even with 81-inch wheels, to force the train into speed quicker that the latter under average conditions of rail.

HOT JOURNALS.

The effect of pouring cold water over hot journals has been discussed a great deal and was one of the topics before the Western Railway Club at its February meeting. It appears to be uncertain just what the effect of the cold water is, but several officers reported that they now insist on removing axles from passenger service after they have been hot enough to require artificial cooling. Several cases of broken axles have been traced to a previous excessive heating of the journals. In answer to the question as to the causes for hot boxes, Mr. J. N. Barr said:

"I believe it would be a great deal harder to answer the question: 'Why don't we have more?' When you consider the weight per square inch of bearing on every car running on our roads, and look at our mechanical appliances and find that we are carrying two or three times the weight per square inch it is safe to run journals on, and that we are making an average of 40,000 or 50,000 miles per car per hot journal, it seems to me that it would be a great deal harder question to answer if it were asked: 'Why don't we have more hot boxes than we actually have?' "

(Established 1832)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE,

MORSE BUILDING....................................NEW YORK

G. M. BASFORD, Editor.

APRIL, 1899.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*
Remit by Express Money Order, Draft or Post-Office Order.
Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn Street, Chicago, Ill.

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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CONTENTS.

Opinion on the Brown system of discipline is now in this country almost universally favorable. It seems to furnish a measure of that vital influence of human interest which is necessary for harmonious co-operation among men who are working together. The system is not by any means in universal use, but its adoption by over 50 railroads, and the all but perfect unanimity of favorable opinion indicate its standing in railroad management. Opinions of foreign railroad papers as recently expressed to the effect that it does very well for small roads, "such as the Fall Brook," and that it "smacks too much of militarism and Pinkertonism," will probably undergo revision when its real standing and importance are understood.

A third man on the engine or some satisfactory method of communication between the engineers and firemen on engines of the Wootten type was the recommendation of the New York State Railroad Commission, as noted last month. A bill has been prepared for the New York State Legislature which, if passed, will go a long way beyond the intention of the commission. The bill requires two regularly licensed engineers in charge of each locomotive in passenger service without mentioning the Wootten type. The object of this proposition would be attained by providing means for communication between the engineer and fireman. This done, we cannot see any advantage in putting on a third man. It is probable that in the case of a Wootten locomotive the third man would not himself discover an accident to the engineer, but would remain in ignorance of it until informed by the fireman. The idea seems "far fetched" and ill considered, and the bill ought not to pass. It probably will not become a law.

The controversy between the "line and staff" in the navy has been settled by the passage of the "Navy Personnel bill," the principle feature of which is the amalgamation of the line officers with the engineers. All officers will be line officers, and those who choose may go into the engineering work, but they will still be line officers in all respects. This does well as far as patching up the recent difficulties is concerned, but it does not settle the question permanently. It puts off the evil day because it is probable that the engines will be intrusted to the care of enlisted men who in time must have recognition. At one time we anticipated a rather different result of this bill and hoped to see the engineer predominate. The best captain or admiral, under modern conditions, would be still better if he came to his position through the engine room. But the bill is passed, and it is hoped that symptoms of belittling the men who are responsible for running the engines will not appear again.

Uniformity in general dimensions of car details has been a subject before the car builder for years without the remotest prospect of a satisfactory result, and it is not an unreasonable supposition that the work of the M. C. B. committee engaged on the sill question for 1899 may be able to present some propositions for the future. There is no doubt that the heterogeneous features of this question are due entirely to want of organized effort to straighten them out. In the case of sills, for example, there is need of concerted action, if from no other point of view than a mechanical one. It is certainly absurd for one builder to put six sills of certain dimensions into a car, and another eight sills in the same capacity of car, and different sizes of sills at that. The absurdity is all the more apparent when even tyros ought to know that a sill cannot of itself carry any part of the load imposed on it. Uniformity is wanted in posts braces and plates as well as in the lower members, and some means ought to be devised to bring this about. There are no arguments against it, and there are many good ones for it.

The proposed organization of the junior members of the American Society of Mechanical Engineers for the purpose of holding regular meetings for presentation of papers should be encouraged and assisted to completion. The senior membership will be improved by it, both now and later, when the present juniors become seniors. Many of the junior members are qualified to prepare papers and discuss them well, they need the benefits of contact with others who are working out engineering problems more even than do the seniors, and the value of such discussion is everywhere recognized. The character of the future papers and discussions before the seniors will be affected in an important way by the success of this movement, and it is hoped that the juniors will persevere and carry out the plan. The national societies of England have done wisely in encouraging the student membership in this way. It is strange that the idea was not started in this country before.

An amusing example of roundabout "labor saving" methods, where direct ones are better and easier, was mentioned by Mr. J. N. Barr, in a discussion on the uses of compressed air, before the Western Railway Club recently. An air hoist, rigged from the smokestack of a locomotive and arranged to lift the steam chests and steam chest covers, was illustrated in the technical press as an improvement. On ascertaining the relative weights of the air hoist and the articles to be lifted, it was found to require less labor to put up the chests and covers direct than than to lift the hoist for attachment to the stack.

Air hoists have been built for loading wheels from the ground into cars at shops where the wheels are mounted. These appliances facilitate the work of loading and they should be used where necessary. Before putting in such an arrangement it would be well to examine the conditions with reference to the possibility of using a depressed track, which may be used for loading other articles and costs nothing for operation and very little for maintenance. Air appliances are so convenient that they are often used because they offer the easiest solution of a difficulty or the cheapest means for securing an improvement. The first cost is not the only cost, however.

Compressed air has been used for producing a blast for forges, and, while it has been believed to be extravagant in the use of power, it remained for Mr. J. F. Deems to indicate the degree of wastefulness. By a simple apparatus, consisting of a small jet nozzle opening into a funnel and discharge pipe, he produced a blast. When the conditions were examined by guages it was found that this blast cost twenty-five times as much as one produced by a fan. The blast method may, however, be used where it is impossible to employ a fan.

The desirability of attaching air compression cylinders to shop engines in tandem arrangement was questioned by Mr. Thomas Paxton in the discussion referred to. The nature of the work done by the shop engine requires the load to be carried at a constant speed, while the reverse of this is expected from an air compressor. The compressor should maintain a fixed pressure or load regardless of its speed. No doubt master mechanics have sometimes been driven to use such a plan because of the difficulties in securing the appropriation necessary to purchasing a proper compressor. Mr. Paxton said: "Good practice dictates that such machines shall give place to the regulation compressor whenever it is possible. Gasoline engines are now combined with air compressors, with the two cylinders direct connected and mounted on the same bed plate. We illustrate one of these in this issue, and with such machines and the other improved compressors available, there should be no extension of the tandem practice as applied to steam engines.

COMPOUND LOCOMOTIVES.

As the compound locomotive is made the subject of careful study, opinions which have been adverse from the start are changing in favor of the type. It is beginning to appear that objections have sometimes been raised to the type when they really apply only to details of design and often to such details as frames and other parts which were not prepared for the stresses imposed upon them and should not be charged against the type. The treatment of compounds before the Western Railway Club last month was noteworthy because the type was now generally accepted as a satisfactory machine as a result of the elimination of weaknesses and a general improvement in the design of the parts rendering them suitable for the peculiar conditions. This may be summed up in this way: The faults of recent compounds are not often those of what may be termed the features of compounding. For some time we have believed that when so well designed that they will not break down on the road, and when the proportions are so chosen that they are satisfactory from an operating standpoint, compound locomotives will come into general use wherever they are used intelligently with a view of adapting them to conditions of operation. It is probable that they will give best results when worked continually up to their most favorable capacity, and a level division where the conditions are very nearly constant will probably be found to be their best field in freight service. It has also been shown that their reserve power obtained by working live steam in both cylinders is exceedingly valuable at critical points near the summits of heavy grades.

The adaptation of locomotives to the particular divisions to which they are assigned is as important a factor in operation as that of increasing their power, and until this fact was appreciated the compound has labored under a serious disadvantage.

The adaptability of the compound to heavy high speed service is forcing itself for attention, and opinions on their advantage for such service are likely to undergo revision very soon. The conditions under which four cylinder compounds are running in France are so different from ours as to prevent comparisons in regard to fuel economy, but the reports of their powers of acceleration, which are commented upon elsewhere in this issue, are interesting as are also the opinions of that type which are offered by the designer.

The general trend of opinion at this meeting was in marked contrast to the tone of previous discussion, and indicated that the compound has many strong advocates, some of whom have only recently become such.

CYLINDER CAPACITIES OF RECENT HEAVY LOCOMOTIVES.

There is an apparently strong tendency among locomotive designers to return to the early practice of giving to locomotives cylinder power closely approaching the limit of adhesion of the wheels to the rail, or, in other words, to give such a high ratio of power, developed in the cylinders to the adhesive weight, as to "over-cylinder" the engines. With the present practice of building large boilers, high cylinder power has a very different significance from that of the time when the cylinders were the governing factor in rating the power of locomotives and boiler capacity was entirely ignored. Then locomotives were crippled in two ways; namely, by a lack of heating surface and steam capacity, and inability to haul a tonnage commensurate with the size of cylinders and pressure, because of an insufficient weight on the wheels to utilize the power in the cylinders. While the newer designs show this slipping tendency, ample provision is made for heating surface and steam storage, and thus the means taken to correct the disadvantages of the small boiler also furnish the weight to hold the modern engine to the rail, and there is little left now as a relic of the old design, except the large cylinder capacities. That there are good reasons for these large cylinder proportions there

can be no question, since an engine is required to exert a maximum drawbar pull for short periods of time only, and this may be done by the aid of sanding appliances, and locomotives may, therefore, be built lighter for a given service, which is an item of no small account to the department of maintenance of way.

In another column of this issue will be found a comparison of the tractive powers of the heaviest engines ever built, which includes both the simple and four-cylinder compound types having the same boiler pressure. The heaviest of these, a simple engine, will develop 3,900 pounds less starting effort than the Lehigh Valley Vauclain compound, although weighing 5,000 pounds more than the latter engine, which has a ratio of tractive power to adhesive weight of practically 0.30, as against 0.27 for the simple engine. It is evident that the compound must start on sand under ordinary conditions when exerting the full cylinder power, but when once in motion there will be 5,000 pounds less weight to tax the cylinders than in the case of the simple engine. This 5,000 pounds, at 8 cents per pound, means $400 more for the simple engine than for the compound of greater capacity, which, from a financial point of view, might appear to be well worthy of consideration. If the simple engine had cylinders 23.75 inches diameter instead of 23 inches it would develop the same effort at the rail as the compound, and at the same time be less liable to slip, owing to the lower ratio of tractive power to adhesive weight.

A comparison of the two consolidations, with 62-inch wheels, one simple and the other compound, described elsewhere in this issue, shows that the cylinders of the simple engine would require to be 23 inches instead of 21 inches to develop the same power as the other engine exactly similar except in cylinder arrangement. Attention is called to these examples of heavy locomotives, for the reason that no claim has been made that the compound is more powerful than the simple engine it is built to replace, economy being the point insisted on. The importance of heating surface in its bearings on the cases noted is not overlooked, but there appears to be an opening more promising for compounds of the four-cylinder type of any build than for either a simple engine or a two-cylinder compound for heavy service, the cylinder size limit being reached much sooner in the latter types than in the former.

GRATES, LARGE VS. SMALL.

Bituminous coal burned successfully in locomotive fireboxes of the Wootten type is a novelty which is full of interest on account of its bearing on the question of large and small grates. The tests on the Philadelphia & Reading, which were recently carried out under the direction of Mr. E. E. Davis, Assistant Superintendent Motive Power, and reported by Mr. Vaughan in this issue, do not appear to prove that Wootten fireboxes are superior to those of the narrow type for bituminous coal, but they do show the possibility of burning that coal in very wide fireboxes without loss in economy. There seems to be justification for the conclusion that if the wide firebox had been deep enough to remove the crown sheet out of the fire, the result would have been more favorable to the Wootten boiler.

The tests by Prof. Goss on the effects of different rates of combustion, the recent fuel tests on the "Big Four" Railway and other experiments have, apparently, not tended to confirm D. K. Clark's conclusion in favor of small grate areas. We say apparently, because it is possible that Clark's proposition has not been fully understood. He said: "There may be too much grate area for economical evaporation, but there cannot be too little, so long as the required rate of combustion per square foot does not exceed the limits imposed by physical conditions."

If Clark thought of sparks when he spoke of "the limits imposed by physical conditions," his often quoted maxim is more favorable to wide fireboxes and large grates than interpreters have been willing to admit. Clark used coke in his famous experiments, and it is evident that the spark losses would be very different between coke and bituminous coal.

Mr. Vaughan found that with good firing an advantage was obtained by using the entire grate area of the Wootten boiler while burning soft coal, and this experiment was the starting point of the more elaborate tests. He found that he could use a slightly larger exhaust nozzle, and that fewer sparks were thrown from the stack when the entire grate was used. In the road tests these observations were confirmed by the comparisons of two boilers, which were as nearly alike as a Wootten and a narrow firebox boiler can be alike. The fuel was referred to the evaporation of water, and we believe the comparisons to be as fair as it is possible to obtain from road tests. The tests extended through six weeks, and every precaution was taken to secure data concerning the coal and water, with a view of making comparisons.

Mr. Vaughan's comments upon the probable performance of soft coal in the Wootten boiler when forced are suggestive. The rate of combustion would increase but it could never reach the high rates attained by narrow fireboxes, and as Mr. Vaughan says the narrow firebox would show a decrease of efficiency under the forcing on account of the spark losses. These tests did not probe the spark question completely, but Prof. Goss has shown us what to expect in this direction.

For a complete understanding of this subject of grate areas, several important factors besides the grate areas must be considered. The front end arrangements, the temperature of the smokebox, the effectiveness of the heating surfaces, the admission of air through the grates and through the fire door, the methods of firing and the spark losses. Prof. Goss found the spark losses in the tests reported in our issue of October, 1896, (page 255), to equal in value all other losses occurring at the grate. These tests give considerable support to those whose tendency in firebox design is toward larger grates and firebox volume that affords ample room for combustion.

YELLOW AS A COLOR FOR DISTANT SIGNALS.
N. Y., N. H. & H. R. R.

For a number of years signal engineers in this country have been seeking for a solution of the problem of satisfactory colors for night signals. There are many arguments in favor of changing present common practice of using red for "stop" and white for "all clear," and it is not necessary to record these further than to note that a white signal light may be mistaken for a stray light that may be adjacent to but has nothing to do with the railroad. Also where white is used for a clear signal a broken glass in a stop signal casting may give a misleading indication and cause a wreck.

The problem has been how to use red for "stop" and green for "all clear" without inconsistency, confusion or uncertainty in the indications of home and distant signals. There is no trouble in using red and green for the indications of a home signal, but a difficulty arises at once with the distant signal owing to the fact that it is not a positive stop signal. Its indication when horizontal, therefore, must be different from that of the home signal, lest we adopt the English practice. The solution has been sought by illuminating the semaphore blade, doing away with the present lights altogether, and this, while very desirable, has not yet been brought to a working success. Efforts have also been made to discover a third color that, while differing from red and green, will be distinctive enough to avoid the danger of being mistaken for a stray light, which will be adapted for use in a distant signal when in the horizontal position.

It has been suggested that white and red should be ex-

changed and white should be used as a stop signal, which would overcome the trouble with broken glasses, but the proposition is too radical to find acceptance even if the cost of changing all switch and train lights was not an obstacle. What is known as the Chicago & Northwestern plan, developed by Mr. E. C. Carter, principal assistant engineer of that road, employs red and green for the home signal and a combination of red and green from one lamp with double lights for the distant signal. In this system the semaphore casting is arranged to give a green light for the "off" position of the distant signal and a red and a green light side by side (from the same lamp) for the horizontal position. This plan has been adopted on the Chicago & Northwestern and has worked very satisfactorily for a number of years, but while it seems to work well this has not put an end to the search for a third color.

Amber and yellow have been repeatedly suggested and have been the subject of a number of experiments, but until very lately they have never been adopted in regular practice, so far as we know, on any road. Several years ago Mr. C. H. Quereau, now Master Mechanic, Denver & Rio Grande R. R., made a series of experiments in this direction for the American Railway Association, and the opinion of that organization was expressed as follows:

"Amber, or yellow, is a combination of red and green. The glasses of this color give a bright signal which can be seen as plainly as either red or green at any distance; but when the color is deep it might be easily taken for red, and when not so deep it could not be definitely distinguished from a white light."

Here the Association left the third color, probably because it was too radical a change to be brought about through a recommendation. The only objection raised to amber or yellow by the association is one of its best recommendations, because if a distant signal using this color for the horizontal indication should be mistaken for white it would indicate a broken glass, which means stop, and if mistaken for red it also means stop. Mr. Quereau found the amber lights that he used clearly distinguishable through long distances, the distinction being stronger at from 1,000 to 1,200 feet than from greater distances. The earlier experiments using "amber or yellow" were generally tried with a reddish yellow, and great difficulties were encountered in securing correct and uniform colors of glass.

Amber or reddish yellow has been discarded altogether, and since 1895 very little has been heard of it. Recent experiments on the New York, New Haven & Hartford have revived interest in this subject, and we recently learned that the semaphore castings for distant signals on that road were being refitted with a view of using what is known as Nels yellow. The change has now been made upon the ten divisions of the Eastern District, and the distant signal arms are now painted yellow, the lights at night being green for "all clear," and yellow for the horizontal position. The matter of lights was thoroughly investigated as a result of the collision at Whittenton Junction on this road Sept. 9 last. This accident was caused by an engineer, who mistook a white lantern on a street crossing gate for a clear signal.

The color of the glass has been carefully studied, and by experiment a satisfactory shade has been found. It is a yellow, not "amber," and not deep enough to be mistaken for a stop signal. The investigation did not end with the color, however, but included the finish of the glass, with a view of giving a distinctive character as well as color to the light. To this end the surface of the glass was formed into irregular corrugations to diffuse the light and give the effect of a "disc instead of a flood of light."

This system is a modification of the English and also a modification of the usual practice in this country. It employs yellow where the English use red in the distant signal. Differences of opinion are held as to the real function of the distant signal, the view taken on this road being that it is merely a repeater for the home signal, and that it gives no rights of itself. The clear distant signal is green, and it is held that no trouble can arise by an absence of distinction between the home and distant signals when clear, and when in the horizontal position the distant signal will give an indication that differs from all others, and one that indicates at once that it is a distant signal and that a home signal in stop position is not far off. The new color might be called white, or it might be mistaken for white without danger because a white signal would indicate "stop," but even if mistaken for white at a distance a nearer approach would make it clear.

With this system the indications will be as follows: Home signal in horizontal position, red; home signal in "off" position, green; distant signal in horizontal position, yellow, and distant signal in off position, green. The lights are said to be very satisfactory to the engineers, and this is enough to say of the success of the change.

Our opinion on the subject of a third color of the order of yellow was expressed in the Proceedings of the Western Railway Club, March, 1895, page 295.

Since these paragraphs were written we have received a communication from Mr. C. Peter Clark, General Superintendent, Eastern District, N. Y., N. H. & H. R. R., from which the following clear statement is taken:

"When the necessity for a distinctive distant signal color was recognized there were only blue and yellow to consider. The similarity of the blue to green, as well as the admitted weakness of the blue light obtained from an oil flame, at once reduced the problem to yellow. The first experiment was made with one of the old-fashioned so-called amber lenses, used on some roads years ago and gradually given up because of the lack of character necessary to distinguish it from a poor white light. The objection had not been removed by the long rest. An assortment of all available commercial yellows in the market was obtained and a series of tests made. While sufficient encouragement to continue the experiments was obtained, nothing satisfactory was found. Experiments covering several months continued. Three lots of glass were specially made, the last of which seems in every way to fill the requirements of the case. The standard adopted is one-fourth of an inch thick, tough, with smooth surface upon one side and studied irregularity upon the other, which gives the light a distinctive character as well as color. The spectacle glass is made at the same time to appear yellow and luminous, instead of simply transmitting a yellow light, which would more nearly resemble a white light under fog and smoke conditions. Until recently a persistent effort of the yellow or orange colors to disclose a reddish suggestion at a distance has been apparent. Although this is in no way objectionable, being on the side of safety—and toward the English practice—a yellow that does not change its appearance is clearly preferable. The spectroscope clearly shows in light passed through the adopted standard yellow glass a mixture of red, yellow and green rays, which, however, blend into a rich, warm yellow for a distance of one-half to three-fourths of a mile. Beyond this the feebler green rays have apparently been exhausted, leaving the red out of proportion. By cutting a smooth lens, 2½ inches in diameter, in the centre of the disc and rendering this part free from the prismatic effect of the irregular surface which appears to be necessary to give the light desirable character, a sufficient amount of the combination yellow is transmitted to a distance of two miles without the objectionable suggestion of red; at the same time the intensity and strength of the light as a signal is clearly increased. While the chemical ingredients of the glass are not disclosed, assurance is given by the manufacturer, Mr. John C. Baird, of Boston, that they are of a metallic base, and free from the objection formerly quoted against yellows because of their vegetable coloring and tendency to fade under the continued effect of the sun and heat from the lantern."

NOTES.

The passage of the Navy Personnel Bill gives the rank of rear admiral to George W. Mellville, M. T. Endicott and Philip Hichborn.

The Baldwin Locomotive Works have received an order for 20 locomotives for the Great Northern of England. The fact is causing a great deal of comment abroad. The original order for 10 engines for the Midland has twice been duplicated, so that this firm has 30 to build for that road.

The North Eastern Railway, England, is building a number of ten-wheel passenger locomotives, the first of this type to be used in England. The cylinders are to be 20 by 26 inches and the drivers 73½ inches, and it is stated that the boilers and fireboxes will be large.

The Pennsylvania Railroad Annual Report for 1898 shows a gain of 5,239,340 tons of freight on lines east of Pittsburgh and Erie over last year and a gain of 7,600,000 tons east of these points. The average rate per ton mile has fallen from 0.536 cent in 1897 to 0.499 in 1898. The average expense of transportation per ton mile was 5.355 cent. The net earnings for east and west decreased $676,914 from last year, while the Western lines showed a net gain of $1,880,744.

"Compressed Air and Its Applications," the topic for discussion at a recent meeting of the Franklin Institute, was opened by Mr. W. L. Saunders in a paper giving a historical sketch beginning at the time of Hero of Alexandria and including a resume of present applications. In the discussion it was stated that 30,000 air compressors were now in use in this country alone for air brakes, and the fact was developed that it was a positive disadvantage to separate the moisture from air to be reheated, as the greater specific heat of the particles of water enables the air to be heated much more rapidly.

The large orders for locomotives booked at the present time presage a season of unusual prosperity for American locomotive builders. Recent orders from the Trans-Siberian call for 81 engines. Sweden orders 20. The French State Railways 10. Egypt 15, and the Midland Railway of England 30. The exceptional equipment and facilities of the American locomotive builder facilitates rapid work, and therefore early deliveries of their product, which is one of the prime reasons why these foreign orders come here. The steady growth of the export of locomotives is shown by the following output: 1896, 312; 1897, 348; 1898, 580. At this rate of increase the foreign trade will soon equal home orders.

Mr. John Birkinbine, member A. S. M. E. and president of Franklin Institute, has formulated plans for taking 5 per cent. of the volume of water rushing down through the gorge at Niagara Falls and thus obtain 35,000 electrical horse power from the unharnessed forces now going to waste at the rapids, where there is a speed of about twenty-two miles an hour. It is proposed to take the above volume of water through a canal, along the foot of the gorge and realize on the 45 foot head of water between the whirlpool and the bridge above. This, according to the estimates, can be done at a cost of about $2,000,000. The canal, when made, is to pass down the gorge between the tracks of the gorge railroad and the precipitous bank, while the power house will be placed at the bend in the river, just opposite the whirlpool. The canal will have a length of 5,300 feet and width of 100 feet, taking water below the bridges and will receive the 10,500 cubic feet of water per second through openings pierced in solid masonry at the head of the canal. This scheme is estimated to cost less to develop than a plant of like power, installed so as to use the direct head of the falls.

FOUR-CYLINDER COMPOUNDS IN FRANCE.

Some valuable records of the performance of French locomotives have been taken during the past year by Mr. Charles Rous-Marten, a complete account of which is to be found in a series of articles in "The Engineer" of London. The chief interest centers in the data on speeds and acceleration taken on trains hauled by the four-cylinder compounds, which have made excellent records, particularly on the Chemin de fer du Nord. While the trains, compared with ours, are light, this road runs a remarkable number of fast ones. Of a list of 24 at speeds of from 50 miles per hour upward, and distances of 50 to 104 miles, seven run faster than 55 miles per hour from start to finish of the trips, and there are many trains averaging from 47 to 49 miles per hour. These figures do not deduct time for stops. One train, between Paris and St. Quentin, 95¾ miles, is scheduled in 102 minutes, or 56.3 miles per hour without a stop. This is the Paris-St. Petersburg express.

Mr. Rous-Marten describes a large number of different fast trains, the speeds of which were taken by the aid of a dynamometer car, and one of these is selected because of the remarkable acceleration that was shown. The regulations limit maximum speeds to 74.4 miles per hour in ordinary express service and on special occasions this may be extended to 77.5 miles per hour, but no faster running is at any time permitted. The train consisted of a corridor saloon, a dining car, a baggage car, an ordinary car and the dynamometer car. Including weights of passengers, estimated, and baggage, the load, exclusive of the engine, was 128 tons of 2,000 pounds. Leaving out of this account a number of interesting features, we note that: "After a cautious start, speed was so rapidly attained that in two miles we were going 60 miles an hour, in three miles 70, and in four miles 71.3, at which pace we started the ascent of the long bank of 1 in 200, which extends continuously for 13 miles, with only the slight breaks of the short level stretches through stations." The speed was sustained for some distance up the grade, and after dropping at one point to 65.4 miles, it recovered to 69, and stood at 68 miles per hour, and was increasing when the summit was reached. This, Mr. Rous-Marten points out, was an average speed of 67 miles per hour up the grade and was exactly the maximum average start to stop speed of any run during the Aberdeen race, including up and down hill and level running.

Another good record was made on a grade of 1 in 333, ten miles long. The initial speed at the base was 40 miles per hour and it rose uniformly until it reached 70 miles per hour at the summit. The entire run of 95¾ miles, from start to stop, was made in 91 minutes 52 seconds. Deducting 6 minutes 41 seconds for slowdowns, the running record was 67.4 miles per hour from start to stop. It will be remembered that the Atlantic City Flyer of the Philadelphia and Reading made 55½ miles at an average speed of 70.8 miles per hour, as recorded in our issue of October, 1898, page 341, but the French engineers are limited in their maximum speeed to 77.5 miles per hour, which makes this a very fine showing for the engines. The fastest mile in the Atlantic City run was made at the rate of 84.21 miles per hour.

The engine making this run weighed 113,000 pounds in working order. The heating surface was 1,890 square feet; the grate area 24 square feet. The high pressure cylinders are outside and the low pressure cylinders inside the frames, the high pressure being 13.4 inches, and the low pressure, 20.9-inch by 25.2-inch stroke. The driving wheels are 83¼ in diameter, and the engine is of the 8-wheel type. The outside cylinders connect to the rear driving wheels, while the inside, or low pressure, cylinders drive the forward pair by means of a crank axle. The boiler pressure is 214 pounds. On the Eastern Railway this is exceeded, 227 pounds being used.

Mr. Rous-Marten acknowledges that the performances of

the French engines surpass the best that he has seen in England, and frankly admits that the French engines are more powerful than any in England. We are not so much interested in this fact, as we are in the large number, between 300 and 400 four-cylinder compounds of the type under discussion, built on the principle introduced by Mr. de Glehn ten years ago, and now running in Continental Europe. The same principles are embodied in the engines of the Nord Railway. In a letter to Mr. Rous-Marten, published in "The Engineer," Mr. de Glehn gives his reasons for designing this type, which may be summarized as follows:

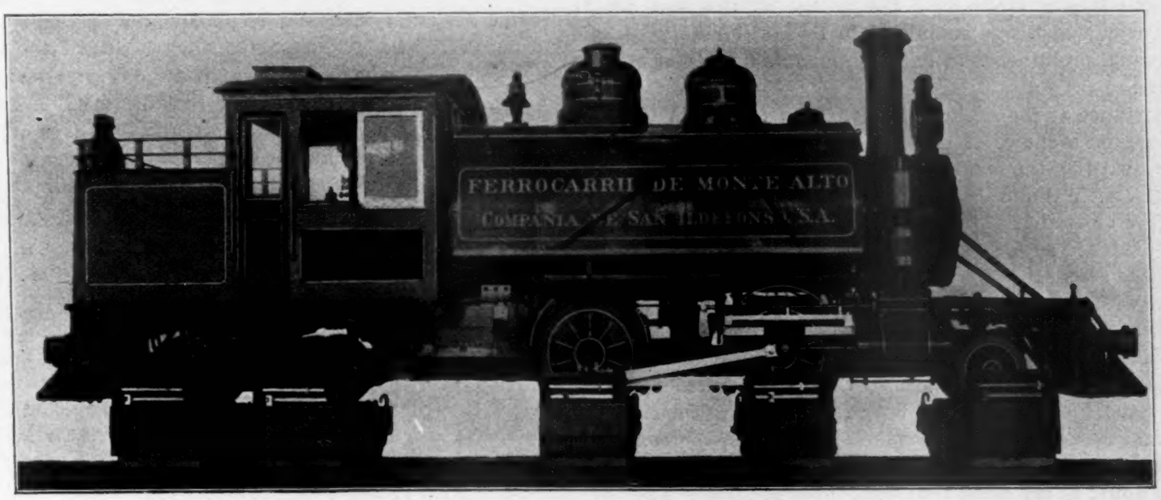
This type was selected chiefly because of the limit imposed upon the weight. The compound type uses steam more economically and therefore weighs less, per horse-power developed, than a simple engine of the same capacity. This is equivalent to saying that larger boiler power may be had without increasing the weight of the boiler. Mr. de Glehn believes that for a given total weight a four-cylinder compound may be made 15 or 20 per cent. more powerful than a simple engine. He finds that the work of the engine is better distributed over the working parts and that with more wearing surfaces there is less wear than with a two-cylinder engine, notwithstanding the increased mechanical complication. He finds that the repairs are less than with simple engines. The four-cylinder compounds are balanced, which has an important bearing upon the cost of repairs, because the engines do not shake themselves to pieces. That they have remarkable accelerating power is illustrated in the figures quoted from Mr. Rous-Marten's records.

SCALES FOR WEIGHING LOCOMOTIVES.
BALDWIN LOCOMOTIVE WORKS.

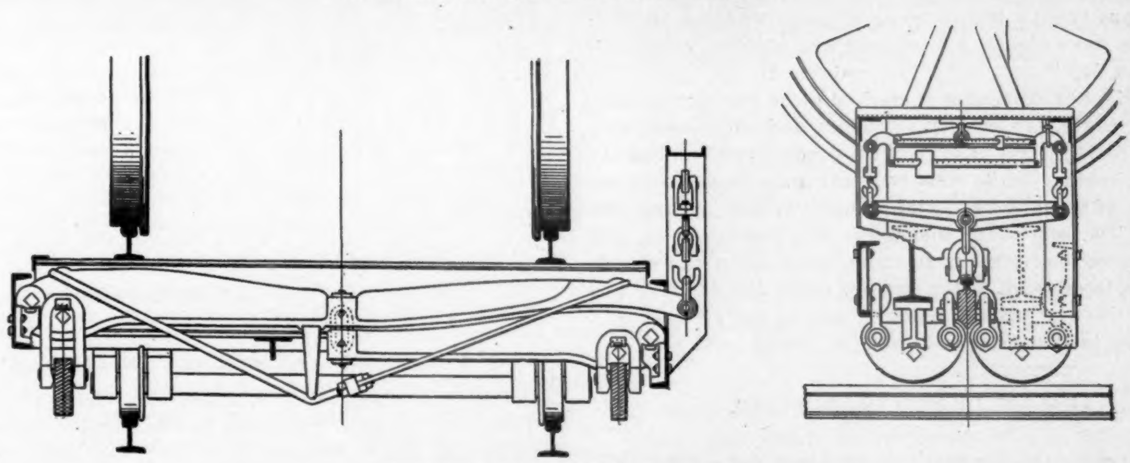
Although rigid restrictions are placed upon the weights of locomotives upon their driving wheels and the loads are calculated sometimes, as far as to include the weight of rivet heads in the boiler, these weights in the finished locomotive are generally guessed at. At least the methods used for obtaining the weights are often not more accurate than guessing, and one railroad in this country has weighed locomotives for thirty years without a fixed rule as to the amount of water in the boiler.

The Baldwin Locomotive Works' method of weighing is shown in the acompanying engravings. The photograph illustrates the method of obtaining tne distributed weight by mounting the locomotive upon small portable scales carried upon wheels, so that they may be moved under and support the wheeels of the locomotive. The practice of these builders is to weigh locomotives with full tank and three gages of water in the boiler. The weights given for the one shown are: Front truck, 11,850 pounds; first pair of drivers, 21,800; second pair of drivers, 22,955; first pair of rear truck wheels, 10,000; second pair of rear truck wheels, 10,500; total weight of engine, in working order, 77,105 pounds.

The weighing machines are very compact. They are about 7 feet 6 inches long by 2 feet 6 inches wide and have a capacity of 60,000 pounds each. They are carried on frames of rolled steel shape and are so made as to avoid all detachable parts, and this applies even to the scale weights.



A Locomotive Mounted on the Scales.



Scales for Weighing Locomotives.
Baldwin Locomotive Works.

STEEL BOILER TUBES.

The attention of railroad mechanical officers has long been occupied with the relative value of steel and iron for boiler tubes, and the question seems to be pressing with as much vigor, and also is as far from settlement as at any time since steel came to claim a share of consideration for this purpose. One of the most serious drawbacks to the use of steel tubes was the difficulty of welding when necessary to piece the ends after removal from a boiler. This obstacle was removed by the production of a material low in carbon, but there is still an objectionable feature in steel tubes that may or may not be eliminated by attention to its chemical composition, namely, that of persistent leakage at the flue sheet after a short period of service, and this fact no doubt had a strong bearing on the report of the Master Mechanics' Committee on the best material for tubes, which was submitted in 1895, although pitting was given equal prominence as an objectionable quality of steel at that time.

The importance of the failure of steel tubes to remain tight, in its bearing on a choice of material, is plainly something to be reckoned with by the maker of those tubes, as the subjoined letter from Mr. William H. Lewis, Master Mechanic of the Morris & Essex Division of the Delaware, Lackawanna & Western, gives evidence as follows:

"I have used steel tubes for locomotives on this division from 1885 to 1894 with the following results: They work all right for a few months after being put in, after that time they give trouble, losing the soft quality they had when new, and they also toughen like rubber, so much so that when rolled again they follow the tool around and do not tighten in the sheet enough to make a good joint, consequently, they soon commence to leak again. I have, therefore, discontinued their use. There is no doubt in my mind that steel tubes are better adapted for use in marine boilers than in locomotives, because of expansion and contraction. Fires in ocean steamers are drawn perhaps twice a month on an average, whereas, in locomotives they have a chance to expand and contract about five or six times a day."

The coefficient of expansion of steel and iron per degree Fah., per unit of length, are exactly the same, and the reason why iron should remain tight under certain stresses due to alternate cooling and heating, while steel will not, furnishes proof that the elements of the latter material require revision to cover the conditions. The serious problems are the prevention of pitting and the trouble in securing tight joints under the severe conditions of locomotive boiler service, which are entirely different from those of marine practice, one of the greatest differences being in the water and its effect upon the metal.

LEAKY AIR BRAKE TRAIN PIPES.

The efficiency of the air brake is no doubt due to the constant vigilance of those directly interested in its performance, by this is meant not those who use but those who maintain it. This is shown by the interest in air brake matters taken by railway club members, and their conscientious committee work. Messrs. F. B. Farmer, G. R. Parker and J. Casey of the Northwest Railroad Club made a report at the January meeting on the waste of air from freight train pipes due to leaks and improper maintenance, with the resulting overworking of the air pump to make the losses good with a consequent waste fuel in compressing air to overcome piping defects.

The committee made it clear that the air brake was at its best only when the proper pressure was maintained in the system, and showed how the benefits of the brakes in safe movements and expeditious handling of trains were sacrificed when from any weakness in the system this pressure could not be maintained. Considerable attention was given to the work required of air pumps other than supplying air to the brake system. Among these was mentioned air for sanding the track operating bell ringers, flangers, blow-off cocks, and also the control of the separate exhaust of one type of compound engine. These drains on the pump were thought to be of not much consequence, however, except in case of the sanding devices and the bell ringer, ranking in importance in the order named.

There was thought to be more leakage in the train pipe than could be well supplied by the pump, without burdening it with the extra work. Much complaint arose from the leaks caused by the escape of air past the coupling packing rings, also those at pipe unions and at the triple valves. In the case of a test made upon a hose coupling by the committee, a leak which was of apparently little account amounted to 133 cubic inches of air per minute at a pressure of 45 pounds per square inch, and it became 210 cubic inches at 70 pounds, and 294 cubic inches at 110 pounds. These figures give a good idea of the additional work imposed on a pump through a leaky pipe system, even when the leaks are thought to be insignificant. It was recommended that large pumps be used for locomotives and also for compressors at terminal testing plants for the reason that best economy could be expected only by having an ample supply to cover all possible conditions.

PROGRESS IN SAFETY APPLIANCES.

The progress made by the railroads in the application of safety appliances to rolling equipment is shown in a recent statement made by the Interstate Commerce Commission. An extension of two years' time was allowed to 294 petitioning carriers in which to equip their freight cars and locomotives with safety appliances, and these report 1,217,636 freight cars and 33,624 locomotives owned on Dec. 1, 1898. There are 117,176 freight cars reported equipped with automatic couplers and 254 reported equipped with train brakes during the six months ending Dec. 1, 1898, which makes a total of 927,823, or 76 per cent., of the freight cars equipped with automatic couplers and 619,252, or 51 per cent., equipped train brakes, up to Dec. 1, 1898. Of the 33,624 locomotives owned on Dec. 1, 1898, there are 30,812, or 92 per cent., which are equipped with driving-wheel brakes. Out of a total of 1,217,636 freight cars there are 289,807, or 24 per cent., that are still not equipped with automatic couplers, and 598,384, or 49 per cent., that are not equipped with train brakes. Of the locomotives there are 2,812, or 8 per cent., that were equipped with driving-wheel brakes on Dec. 1, 1898. There were 651 cars destroyed and 600 sold of the total number reported equipped with automatic couplers. Of the total number of cars equipped with train brakes since Jan. 1, 1898, there were 138 destroyed and 600 sold.

AMERICAN LOCOMOTIVES IN ENGLAND.

The Midland Railway of England is so well organized and equipped as to cause controversy in that country concerning the necessity for the recent orders for American locomotives, and the chairman of the road furnished an explanation in a recent speech, which was reported by English papers, in abstract, as follows:

"It would be seen that the directors had ordered some locomotives in America, and, as this was a new departure, no doubt some information on the subject would be of interest. He would much prefer to order goods of any kind that were of home manufacture, and he might say that the question of cost was not one that entered into the calculations of the directors when asking for tenders from over the water. The increase in their train mileage had been very large lately, being in 1898 considerably over 2,000,000 miles; and it was obvious, therefore, that additional engines must be purchased. For years past their locomotive superintendent (Mr. Johnson) had impressed upon them that they worked their engines too hard. He believed the ideal position, according to Mr. Johnson, would be that they should have 75 per cent. in steam; but 90 per cent. had been much nearer their figure, so that there was no margin. They had now on order in this country 170 engines. They commenced ordering in December, 1897, and the first delivery should have been made in July of that year, and they should

have been receiving a number in each month, which would have made up a delivery to the present time of 48 engines. The company had not received one of these. The last order given was in November of last year, for 20 engines, at an extravagant price, and the makers did not even promise delivery of one for 15 months, the order to be completed in May, 1900. Locomotives were a necessity to the company; they must have them, and so the directors determined to ask for tenders from America. They asked for tenders for 10 engines each from two firms—the Baldwins and Schenectadys—and they received offers to deliver in the one case within 10 weeks from the date of the receipt of all necessary information for construction, and in the other case shipment from America was promised for March next. This offer was made in December, so that, while the directors could not get an engine made in England and delivered in Derby in less than a year and a quarter, they could get 20 from America in four months. The engines would be of the American type, with certain alterations which Mr. Johnson considered desirable. They would be of the same power as the Midland engines, and it would certainly be interesting to watch their performance, as Mr. Johnson—and he hoped all his staff—intended that they should have fair play in every particular."

SAVING BY USE OF COMPRESSED AIR IN RAILROAD SHOPS.

We have come to be very familiar with the diverse uses to which compressed air is applicable in shop operations, but the comparative cost of this convenient agent with methods it displaces has not been available prior to the reading of a paper having the above title before the Western Railway Club by Mr. B. Haskell, Superintendent of Motive of the Chicago & West Michigan. In the case of loading wheels by an 8-inch air hoist, a car is loaded at a labor cost of 15 cents, while the old manual style of loading by means of a long incline to the floor level of the car cost for labor $1.02, giving a saving of 87 cents per car. The same hoist is also used for loading and unloading, reducing the cost of handling material 50 per cent.

By the use of pneumatic hammers the cost of beading a set of flues is reduced from $2.50 for hand work to 75 cents by air. The cost of tapping staybolt holes and screwing in staybolts by air motors has been reduced from $45.90 for hand work to $15.30 on a new firebox. A saving of $13.16 per firebox is effected by drilling the ends of staybolts with the motor at a cost of $4.62, while by the old way the cost would be $17.78. A set of tires is removed for 50 cents and replaced for 87.5 cents, the figures in this case, however, do not include labor. In the preparation of a new locomotive for priming coat of paint the surface is brought to condition by the air and sand blast instead of by hand abrading, the latter process requiring about 35 man-hours at a cost of $3.50, while the sand blast requires two man-hours at 14 cents an hour and two man-hours at 10 cents an hour, or 48 cents, a saving of $3.02 by the sand blast.

The sand blast is also used in frosting deck glass for passengers cars, the cost per glass for labor and material being 12 cents, or a saving of 60 cents. The cleaning of coaches by air is done at a cost of 87 cents per car, a wide, flat nozzle being used. One man only is required to move cushions and seat backs, blow all dust out of them and the interior of the car and complete the cleaning of the car ready for the road in three hours, while beating by the old way required ten hours. The painting of cars by the paint spraying machine has reduced the cost for labor approximately 92 per cent. The same spraying machine is used for whitewashing, which is done on plain surfaces at a cost of 1 cent a square yard for labor and material. A saving of 67 cents per car in applying two coats to a 34-foot box car is shown by the paint spraying machine over hand work. The following statement gives the itemized cost for both methods:

By Machine.

Labor, 40 minutes, 12.5 cts	$0.08
Lettering, 3 hrs, 12.5 cts	.37.5
Five gals. paint, 60 cts	3.00
Two lbs. white lead, 6 cts	.12
	$3 57

By Hand.

Labor, 6 hrs., 12.5 cts	$0.75
Lettering, 3 hrs., 12.5 cts	0.37.5
Five gals. paint, 60 cts	3.00
Two lbs. white lead, 6 cts	.12
	$4.24

The savings effected by pneumatic tools have brought about a revolution in many operations, for example as noted in the paper, all operations on firebox work. With the pneumatic hammer it costs 25 cents to caulk 100 flues; hand work costs $1.05, or a saving of 80 cents per hundred flues for airwork. In the matter of staybolt holes, one man at 15 cents an hour will tap out by hand from 75 to 80 holes in ten hours, whereas, with the machine he can do 175 to 200 holes in the same time, and putting in staybolts, one man at 15 cents an hour will put in by hand from 175 to 200 bolts in ten hours, while for a like period the air tool will put in from 300 to 400.

These brief abstracts will doubtless have more weight with intending purchasers of air tools than would the claims of builders of the tools. In any event, the figures are interesting, as showing how the cost of some shop work operations are affected by the use of modern air appliances, and they carry their own moral.

Some very rapid work in car erection was done not long ago at the Water-Valley shops of the Illinois Central. Master Mechanic Curley, having some 50,000 pound coal cars to build, instructed his foreman, Mr. F. W. Taylor, to take six men and put up one car, including air-brake equipment, and note the time occupied on the work. The six men completed it in exactly three hours and fifty minutes, including one coat of paint. It should be understood that the trucks and as far as possible all other work was ready for putting up and assembling when the construction was begun. This work was undertaken to vindicate Mr. Curley, who had put up two 40,000 pound cars in 1883 with the same force per car, in eight hours, but without air brake, which story was always doubted. He is supported by a statement which we have received from Mr. F. W. Brazier, Assistant Superintendent of Motive Power of the road.

The following table of the boiling points of liquified gases at ordinary atmospheric pressure, reprinted from "Engineering," may prove useful as a record:

	Deg. Cent.
Sulphur dioxide	10
Chlorine	33
Ammonia	38
Sulphuretted hydrogen	62
Carbon dioxide	78
Nitrous oxide	88
Ethylene	102
Nitric oxide	153
Marsh gas	164
Oxygen	183
Argon	187
Carbon monoxide	190
Air	192
Nitrogen	195
Hydrogen	238

Mr. John S. McCrum died of apoplexy at his home in Kansas City, Mo., March 20, at the age of 61. Mr. McCrum was for many years Superintendent of Motive Power and Machinery of the Kansas City, Fort Scott & Memphis. He began his railroad career as an apprentice to the machinists' trade on the Pennsylvania Railroad in 1854. His railroad experience was a varied one, embracing a service of four years as machinist and engineer in Cuba, besides four and a half years with the United States military roads, and one and one-half years as an engineer on the Kansas Pacific. His connection with the Kansas City, Fort Scott & Memphis began in 1869, and from 1870 to 1895 he was in charge of the machinery department of that road.

The National Electric Car Lighting Company has received orders for car lighting equipment for use on a car on one of the Russian railroads, for an application to an officers car on the Illinois Central, for the private car of Vice-President Crocker of the Central Pacific and for eight postal cars on the Atchison, Topeka & Santa Fe. The last mentioned equipment and the one in Russia have been applied and are now running. The Atchison has a number of cars lighted by this system as has been noted in these columns.

CHILLED WHEELS FOR 100,000 POUND CAPACITY CARS.

It seems eminently fitting that the Carnegie Steel Company should have been the first to experiment on a large scale with steel cars having a carrying capacity of fifty tons, as no company was better qualified to draw up specifications for the material entering into their construction. A glance at the specifications on which bids were finally asked for the 100,000-pound steel hopper cars built for the Pittsburg, Bessemer & Lake Erie Railroad, shows how thoroughly they entered into a consideration of all the details, and it will be noted that the bidder was left no opportunity to put in inferior material, the maker from whom the various parts would be purchased being definitely specified. The method employed for deciding on the wheels to be used may be taken as an indication of the thoroughness with which the Carnegie Company went into the whole subject, and as typical of the course followed for all the parts entering into the construction of the steel car.

Letters were sent to the leading wheel manufacturers in various parts of the country, stating clearly what was required, and asking that a special design be submitted of the wheel that would in their opinion be the best suited to meet the unusually severe conditions, together with bids for furnishing the number required. The designs were then considered without any reference to the price quoted, but entirely on their merits, and it was pre-eminently a case of "the survival of the fittest." It was an open question whether any cast-iron wheel would stand the repeated and severe heating due to the long continued brake action necessitated in stopping so great a mass, and whether the large proportion of cracked plates resulting would not make the chilled wheel uneconomical, even if the strains did not cause breakages in service.

The New York Car Wheel Works, of Buffalo, N. Y., were among those invited to bid, and they submitted a design for a 33-inch wheel weighing only 50 pounds more than those used under 60,000-pound cars, but made of special qualities of iron from which they had obtained very greatly increased strength. This company took the position that it was undesirable to increase the weight proportionately to the increase in load, as that tended to set up shrinkage strains in the plates, which would only increase the likelihood of their cracking, but they recommended obtaining the requisite strength by using good qualities of iron and submitted tests that they had made and records of service that had been obtained from their special wheels under locomotives to prove that the increase in strength was there. Briefly, this increase in strength may be best shown by comparing the breaking strains of test bars made from both mixtures one inch square and twelve inches between supports in transverse strength. With the best foundry practice and ordinary mixtures, a bar of this dimension would show a transverse strength of from 2,600 to 3,000 pounds, but by the use of their special mixtures these manufacturers were able to obtain from 3,500 to 3,800 pounds, an increase of about 33 per cent. The New York Car Wheel Works T. M. Special wheel was specified under the first 600 100,000 pounds capacity steel cars built for the Pittsburg, Bessemer & Lake Erie Railroad, and later under the additional 400.

It was further specified that the wheels should be "machined" on the tread, i. e., rotated between rapidly revolving emery wheels touching the tread at two opposite points that not only took off any slight irregularities, but left the wheel truly round, and this was also in accordance with the wheel company's recommendation, as the absolute roundness of the wheel reduces the likelihood of "skidding" to a minimum.

Two things may have had a decided bearing on the decisions to use this wheel, and these were the fact that the manufacturers had been making an especial study of the production of wheels of high grade for particularly severe service, and the other that owing to the system of comparative tests under which their wheels are made, there was an absolute certainty that no wheel could be shipped that fell below a certain standard determined upon beforehand. By means of these tests, the transverse strength of the metal and the depth and hardness of the chill are accurately determined before the wheel leaves the foundry.

The specifications under which the wheels were made called for the Master Car Builder's test with a minimum of fifteen blows, one wheel being selected at random by the inspector out of each one hundred as representing this lot. Other tests that were to be made at the discretion of the inspector were the Pennsylvania Thermal test and the Austro-Hungarian test. Below we give the actual results obtained, which are certified to by the Carnegie inspector.

Chilled Wheels for 100,000 Lbs. Capacity.

Number of Blows of 140-Lbs Weight, Dropping from a Height of 12 Ft., Required to Break 650 Lbs. Special Wheels Furnished to the P., B. & L. E. R. R. for 100,000 Lbs. Capacity Cars.

Date tested.		Blows to crack.	Blows to break.	Date tested.		Blows to crack.	Blows to break.
May	17	61	94	Sept.	17	61	112
"	18	73	85	"	18	63	85
"	19	54	91	"	21	39	71
"	20	50	100	"	21	32	55
"	21	56	111	"	22	23	111
"	22	43	76	"	22	55	123
"	24	54	78	"	23	37	57
"	25	43	66	"	23	21	85
"	26	48	85	"	24	73	107
"	27	24	50	"	24	40	134
"	28	15	60	"	25	39	108
"	29	26	47	"	29	57	136
June	1	28	33	Oct.	1	45	66
"	2	9	99	"	1	70	182
"	3	18	78	"	1	78	123
"	4	30	74	"	4	35	61
"	5	64	106	"	5	55	111
"	7	34	78	"	5	62	86
"	8	32	45	"	6	60	110
"	9	49	80	"	6	61	88
"	10	55	76	"	7	72	157
"	11	44	106	"	9	86	170
"	12	60	151	"	9	62	81
"	14	68	141	"	11	88	205
"	15	78	92	"	12	34	57
"	16	73	161	"	14	71	120
"	17	44	216	"	14	63	111
"	18	116	182	"	14	60	106
"	19	66	151	"	15	54	114
Sept.	15	77	114	"	16	50	101
"	15	60	89	"	21	30	47
"	17	65	143				

Average of 63 car wheels, 102 blows to break.
On the Master Car Builders' Test ordinary wheels are accepted if they successfully stand five blows.

On looking over this list, in which each wheel represents a lot of one hundred, one is immediately struck not only by the fact that the number of blows that it took to break the wheel far exceeded the specifications, but that in nearly every case as many blows were struck after the wheel was once cracked before it broke, as it took to crack the wheel. In every case but one, the wheel did not even crack until the number of blows specified was passed, and in that one case, the cracked wheel stood ninety additional blows before it broke. No better demonstration could be given of the strength and of the toughness of the iron in the wheels than this gradual failure. The results the wheels are showing in service is quite as remarkable as the tests, as out of the whole 8,000 furnished, which have now been running over a year, as far as can be learned, not one has yet been removed for any cause.

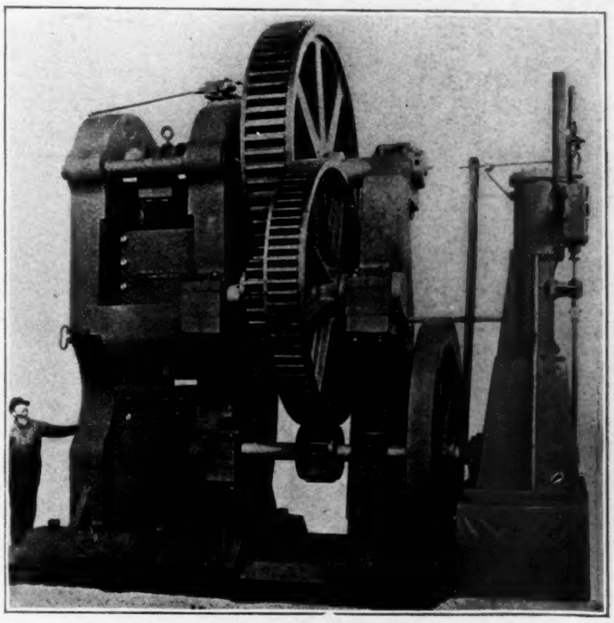
General Manager Underwood, of the Baltimore & Ohio Railroad, has issued the following general notice to station agents and trainmen: "Your especial attention is directed to the treatment of patrons by employees of the company. Complaints have been made from various sources of discourtesy to freight and passenger patrons on the part of our agents, or their representatives, at several of our stations, and also inattention of conductors and brakemen to properly care for the comfort of passengers. There should be no cause for such complaints. It is a part of your duty to see that our patrons are treated at all times with politeness and courtesy, not only by yourself, but by employees under your charge. One of the valuable assets of a railroad company is uniform politeness and courtesy from all of its employees to its patrons, and this capital must not be encroached upon. It is proper for you to understand that advancement does not depend wholly on your efficiency, but in other directions also, and will be measured in a great degree by the treatment accorded to patrons."

MONSTER BLOOM SHEAR.

The Long & Allstatter Co.

The Lorain Steel Company, of Lorain, Ohio, have recently received a very large shearing machine, built especially for them by the Long & Alstatter Company, of Hamilton, Ohio. The engraving shows the appearance of the machine and an idea of its proportions is given by comparison with the height of the man standing beside it.

The work to be done is in cutting steel blooms, and it will cut these as large as 10 by 10 inches in section, or 100 square inches of metal at a single stroke. This shear is located beside another, which has been at work for several years, the two being placed close together to permit of being attended by one man.. The machine is 21 feet high, its total weight is about 250,000 pounds, and each housing weighs more than 54,000 pounds. The steel castings used weigh about 35,000 pounds, while the cam shaft which operates the slide weighs more than 10,000 pounds. These figures give an idea of the size of the shear. The stroke is 10½ inches.



A Large Bloom Shear.

The cylinder is 14 by 18 inches. Tilting of the bloom, while being cut, is prevented by an automatic and adjustable attachment for holding it down and a gage determines the length for cutting. The shear and outboard housing are mounted upon a heavy bed plate with octagonal ways, upon which they may slide for convenience in making repairs, and these also serve the purpose of keeping the parts of the machine in line. We are indebted to the Long & Alstatter Company for the photograph and particulars.

STREET CAR BRAKES.

The announcement of the prospective tests of street car brakes to be conducted under the direction of the New York State Railroad Commission has awakened a greatl deal of interest in this subject, and our attention is called to the merits of a brake that has been in successful and apparently entirely satisfactory use for the past four years on the lines of the Metropolitan Street Railway in New York. We refer to the Sterling Safety Brake and desire to do justice to it in view of the sweeping statement printed on page 93 of our March issue. The Sterling Supply & Manufacturing Co., 141 East Twenty-fifth street, New York, the makers are prepared to show that the record on the Metropolitan has not been surpassed anywhere.

The device is an improvement upon the old style of hand brake, it is operated by hand and consists of a pinion, operated by the brake shaft or spindle, which meshes into a gear and sprocket wheel cast in one. The sprocket wheel carries a double chain connection—the object of the double chain being that, in the event of one chain breaking, the other remains operative. By the gear and pinion added power is obtained. The ratio of gearing of the pinion to the gear is 2 to 5. These parts are contained within a housing, which is placed directly under the platform of the car and the entire mechanism takes up a very small space.

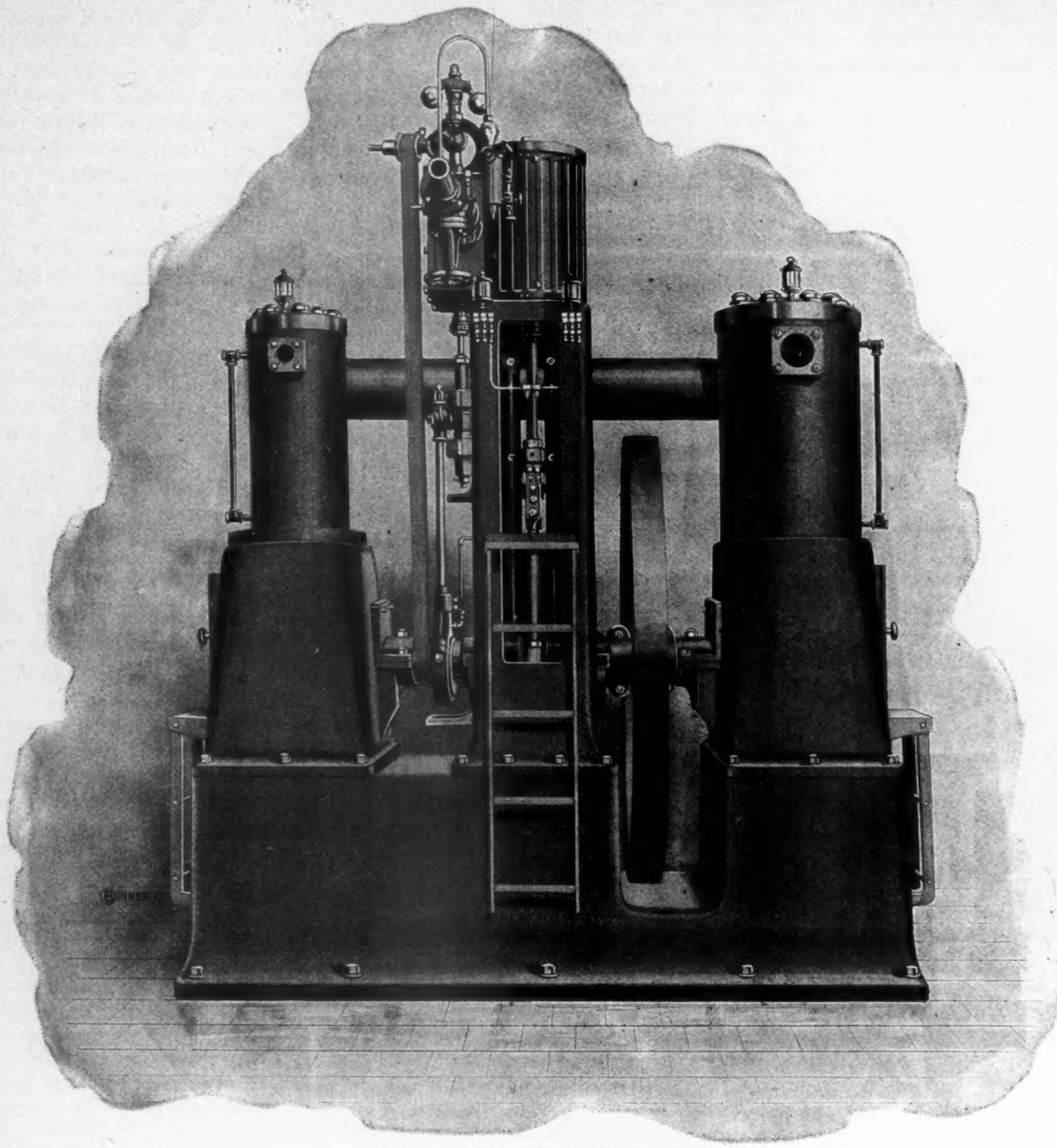
The advantages urged in favor of this system are that it is controlled directly by the motor man and does not depend in any way upon automatic apparatus, it is designed to reduce wear to the minimum by placing the chains around a sprocket wheel that is large enough to distribute the load over a proper length of chain. It is held to be better than brakes using auxiliary power and is sufficiently rapid in action and much more certain owing to the danger of failures with auxiliary power, especially where stops must often be made quickly and frequently. The cost of auxiliary power brakes is greater, and while no claim is made that the Sterling brake is advantageous for high speed suburban traffic it has satisfactory claims for attention for its sphere, city railroad work and for braking cars running singly.

SAFETY CHAINS FOR PASSENGER CARS.

A committee comprising Mr. J. M. Holt and Mr. C. F. Thomas, of the Southern Railway, submitted a report on safety chains to the Southern and Southwestern Railway Club at the January meeting. The efforts of the committee were directed to an improvement of the design at present in use, so as to prevent as far as possible the danger of trains parting from weakness of the chain connection, it having been found that the chain and hook adopted by the M. C. B. Association in 1890 could not be depended on to withstand a load of more than 35,000 lbs. These chains were known to be too weak to hold a train together in case of failure of the draw-bar, and the committee devised a safety chain and attachments intended to be reliable under all conditions of service. The safety chain proposed will stand a load of 75,000 lbs. before rupture—the test showed 77,000 lbs.—and after a service of more than a year with the most satisfactory results, they are being applied to the entire passenger equipment of the road. The improvement consist in designing the chain and hook—one link and one hook—with the proper amount of metal in the proper place, which after all is simply correct design. There has long been need for improvement in the strength of this detail, particularly in mountain districts and where reverse curves abound, and this fact seems to have been fully recognized in the work of the committee, for the chain has been designed with the view of either one taking the whole load in the event of the failure of the draw-bars on curves.

MEETING OF THE A. S. M. E. JUNIORS.

A meeting of the junior members of the American Society of Mechanical Engineers was held at the society house on the evening of March 7 for the purpose of effecting an organization for the purpose of holding regular meetings for the presentation of papers and discussions upon them. The idea is an excellent one which should be encouraged, and the younger members should have all necessary assistance in perfecting their plans. The first meeting was not a great success, as far as the proposed organization is concerned, but many of the seniors were attracted by the illustrated lectures by Chief Engineer Gardiner C. Sims and Lieutenant W. S. Aldrich, describing the supply ship "Vulcan," and the experiences of that ship off Santiago. The raising and attempted towing of the Spanish ship "Maria Theresa" to the United States were also described. These topics were intensely interesting. The organization of the juniors appears to be promising, although comparatively little was done at the first meeting.



A Steam Driven Shop Air Compressor.
Curtis & Company Manufacturing Company.

A STEAM DRIVEN, SHOP AIR COMPRESSOR.

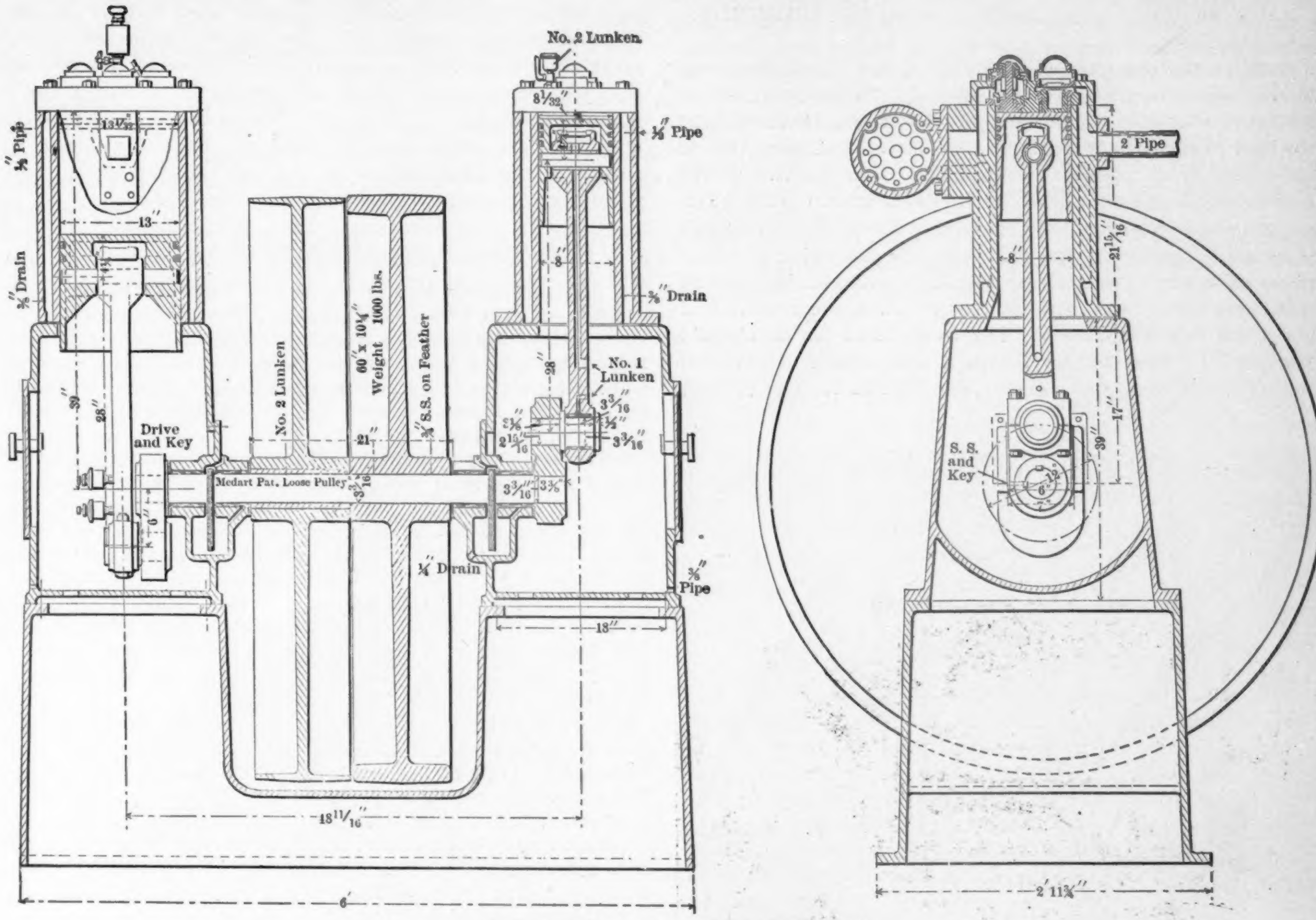
Curtis & Co. Manufacturing Company.

These engravings illustrate an air compressor especially designed for the constant maintenance of a working supply of compressed air in machine shops, boiler shops, foundries and similar places, where it is a growing practice to employ tools and other appliances operated by compressed air. The compressor is steam driven with a direct connected vertical engine. The machine is designed to run continuously, and the engine is controlled by a Gardener throttling governor, with a heavy yoke throttle valve. The governor is ordinarily fitted with a slow-down device, controlled by the air pressure, so that the governor valve is nearly closed when the air pressure in the reservoir reaches the desired point. When the service is very intermittent, a Curtis relief governor is added, so that the machine will not compress when running slowly, thus practically consuming no power except when air is needed.

The sectional engraving shows the front and side of a belt-driven compressor, 13 and 8 by 12 inches; but, as far as the compressor part is concerned, the construction is the same as that of a steam-driven machine, and the engraving shows the machine, with a low-pressure cylinder, 16 inches diameter and 16 inches stroke, the high-pressure cylinder being 10 inches diameter by 16 inches stroke; the cylinders and cylinder heads are thoroughly water jacketed; the compression is in two stages, with a sufficient intercooler between the cylinders, with a large capacity when compared to size of the cylinders, so that air is thoroughly cooled when passing from the high to the low pressure cylinder. The intercooler is filled with thin brass tubes, through which the water circulates. The cooler is designed according to the best practice in marine engine condensers. Both heads provide for expansion, and the bolts which are exposed to the water are of bronze to prevent corrosion. The intercooler is bolted directly to the cylinders. Properly located partitions in the cylinder, water jackets and intercooler compel a thorough circulation of the cooling water. Drain cocks are provided to drain the intercooler and water jackets.

The capacity of this machine, running at 120 revolutions, is 200 cubic feet of free air per minute. The compressor will work easily against 110 pounds pressure.

The size of the steam cylinder is determined by the boiler pressure and the desired air pressure. As will be seen, the compressor is entirely inclosed, but the working parts are easily accessible; by a hinged door at the side, the connecting rods, cranks and main bearings are accessible, and all valves are in the cylinder heads, each valve having its own cap and



A Belt Driven Shop Air Compressor.

Curtis & Companv Manufacturing Company.

being independently removable. The location and form of the valves are such as to reduce the clearance to almost nothing. In the half-tone the high-pressure cylinder is nearest the observer, and the air is discharged at the side flange to which the pipe to the reservoir or line is to be attached.

The free air enters at the side flange of the other cylinder through an air pipe, which may lead from the outside of the building. The provision for lubrication of every working part is deserving of notice. There are chain oilers on the main journals, a pressure grease cup takes care of the upper pin and the crank pins dip in oil at each revolution. The oil cups on the engine are filled by an oiling system centering at the centre of the engine, just below the cylinder.

The design of this compressor is quite novel, both cylinders being single acting, which does away with stuffing boxes, and gives a cooling area 80 per cent. greater than a double-acting cylinder, greatly increasing the efficiency.

This machine is self-contained and weighs a little over 13,000 pounds. All parts are very liberal in proportion, insuring stability and durability and admitting of using light foundation. The automatic regulation makes it economical for intermittent work. The engine is simple and strong; it is connected to the compressor with cranks at right angles, causing very smooth running. The parts are easy of access and are not crowded or overloaded with duties and small intricate forms, for complicated details have been avoided.

The machines are equipped with a fly wheel 5 feet 6 inches diameter, weighing 2,000 pounds. The machine base is 8 feet 7¼ inches by 4 feet 6 inches; the total height is 11 feet.

Curtis & Co. Manufacturing Company, of St. Louis, Mo., are manufacturers of this and similar machines, both belt and steam driven, in sizes from 25 to 200 cubic feet of free air per minute. They also make a specialty of air hoists and general foundry equipment.

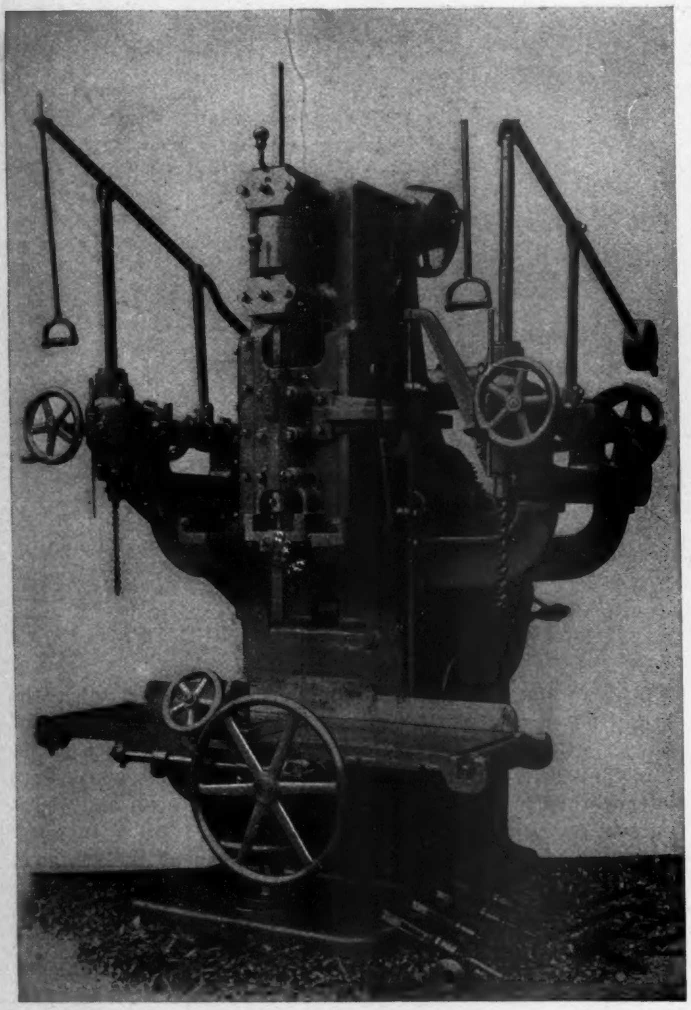
MODOC SOAP FOR CLEANING CARS.

It is an unusual thing to find passenger cars with the bright sheen of the paint shop on them after a few months' service. Cars that are neglected very quickly reach a condition that is irreclaimable, as far as a respectable appearance is concerned, without the aid of varnish, for soap and water applied to a car on which dirt has been allowed to accumulate is one of the worst remedies that can be applied, as it is a deadly enemy to varnish as well as paint. In any event, repeated washings with soap have the effect of dulling the varnish and putting it in a more receptive condition for dirt. Having recently noticed the well-groomed appearance of some coaches of the old standard yellow color, a color that is handsome when clean, but one not well adapted to resist dirt, some inquiries were made of an official touching the method of cleaning. We were informed that they were cleaned every thirty days with Modoc Liquid Car Cleaner at a cost of $1.25 per car, which low figure is accounted for by the fact that the cars are not allowed to get dirty and are, therefore, easily cleaned.

This liquid cleaner does not clean a dirty car as quickly the first time used as soap and water, for its components are weaker and therefore less harmful to varnish and paint. These cars, when very dirty, are first cleaned with Modoc Powdered Soap and afterwards dressed with the liquid, using no water whatever, leaving the cars as bright and clean as though just out of the shop, and this result, we are informed, is obtained with any color, whether yellow or the standard Pullman. The appearance of these cars justified the claim that there were none finer.

A NEW VERTICAL HOLLOW CHISEL CAR MORTISING MACHINE WITH AUXILIARY BORING ATTACHMENTS.

Builders and repairers of cars, and, in fact, those concerned in any contruction where heavy mortising is required, will be specially interested in the new No. 4 Vertical Hollow Chisel Mortiser designed and built by J. A. Fay & Company, 516 to 536 North Front street, Cincinnati, O. This machine is the most powerful and reliable of the kind ever offered to the wood-worker, and is remarkable in containing the essential elements of strength, simplicity, and efficiency, the possession of which are so necessary to satisfactory results in any machine; results that are attained, too, without requiring the work to be laid out or the mortises cleaned. The frame is of the usual solid type built by this company, with a distribution of material looking to lightness and stability, requisite to rigidly support



A New Vertical Hollow Chisel Car Mortising Machine With Auxiliary Boring Attachments.

the housing, the chisel ram, boring attachments and table. The housing has provisions for taking up wear, and has a lateral movement for properly locating the chisel over the work. The chisel-ram carries the boring spindle, the latter running in a long self-oiling bearing. There are stops by which the vertical movement of the ram is regulated for the depth of mortise; this movement is 16 inches, while the lateral action, with the housing is 14 inches. The chisel-ram has a reciprocating motion due to reversing friction and gearing. The table on which the work is supported is 4 feet 6 inches long, and also has stops to control the movement for the length of mortise required. The table is operated by a hand wheel in connection with a rack and pinion, and has an adjustable clamp for holding the work securely in place while operated on. The auxiliary boring attachments are located at each side of the machine sufficiently distant from the chisel to allow an adjustment to an angle of 30 degrees in either direction, and they are also provided with a vertical adjustment of 20 inches and a lateral movement of 12 inches. This machine, which is the product of a corps of experts constantly engaged in design of wood working tools, represents the best thought yet put into this form of machine for accurate and rapid work.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

A geodetic observatory is a necessary part of the equipment of an institution giving instruction in geodetic methods of surveying. The plans for the erection of such an observatory near Boston have been under discussion ever since the adoption of what is known as the geodetic option of the course in civil engineering, but it was not until May of 1898 that the observatory became an established fact.

This observatory is intended primarily to be used in giving instruction in the most refined methods of determining Latitude and Longitude, and secondarily to be used in magnetic and gravity observations. A hill in the southeastern part of Middlesex Fells was chosen for the site. Here was found a firm foundation for the most delicate instruments, free from the vibrations caused by railroad and highway traffic and not too far from Boston. There is an unobstructed view of the heavens and the horizon, with the two United States Coast Geodetic Survey triangulation stations, at Blue Hill in Milton and Prospect Hill in Waltham, in plain sight.

The Park Commissioners kindly granted permission to the Institute for the erection of the building, with the provision that it should be built of field rock and with pleasing proportions. The exterior was designed by Professor Homer. The building is of stone; it is fifteen feet square and contains the following apparatus, namely: a transit instrument of two and one-half-inch aperture, twenty-seven-inch focus, with a delicate level and micrometer eye-piece for latitude observations; a sidereal chronometer; a chronograph; a magnetometer; a dip circle; an altazimuth instrument, and various other smaller appliances, such as a heliotrope, a self-recording barometer, etc. During the present year it will be further equipped with a one-half seconds pendulum fo rdetermining the force of gravity.

Much work has been done at the observatory that could not before be performed at any of the Institute buildings. This is especially true of the tests on delicate spirit levels and the determination of constants depending on such observations. This is due to its freedom from vibrations, while its distance from all magnetic disturbances renders it especially favorable for observation with the magnetometer and dip circle.

The observatory, on account of its unique position, will be a valuable magnetic station and its observations will probably be incorporated in the general magnetic work of the United States Government.

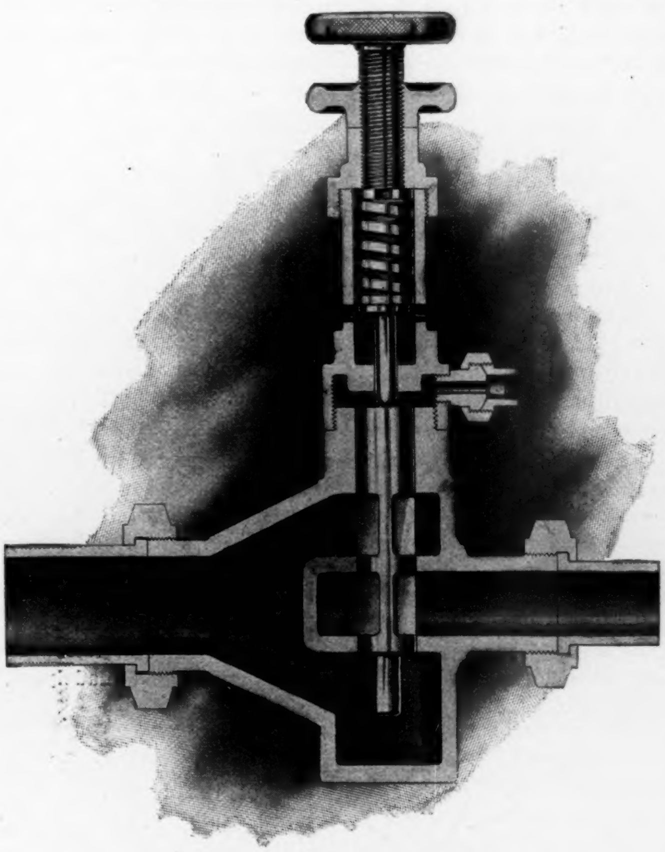
DRAW BAR YOKES.

The subject of draw bar yokes was among the matters up for discussion at the January meeting of the Central Railway Club, the special feature centering on the weakness that is developing at the solid back end of the yoke, which breaks at the corners of the junction of the back end with the top and bottom. Mr. Waite mentioned a car coming under his observation where there was no doubt that red short iron was responsible for the failure. The importance of the radii of the bends at the back end was referred to by Mr. McCarty, who also pointed out the necessity for avoidance of square corners at that point. The reduction of thickness of material at the corners of a one by four-inch yoke was shown by Mr. West to be fully ¼ inch, which was due to the drawing of the metal over the form on which they were shaped. Many of the yokes he found were reduced to even less than ¾ inch thick at the corners. He understood that the Cleveland City Forge had devised a means of upsetting these corners and were furnishing a pocket which he was using. Mr. Waite thought that accounted for the reason why he had no trouble on his road, as he used the Cleveland City Forge Company's pockets. There is no doubt that reinforcing the corners is a good thing to prevent breakage, and Mr. McCarty's proposal to increase the radius of the ends will be found beneficial in all cases.

"ECLIPSE" REDUCING VALVE.

For Locomotives and Marine Service.

This reducing valve is simple and is making a name for itself on several railroads and steamships. Steam enters the valve through the pipe shown at the right hand side of the engraving. The piston is loose for vertical movements, and in the absence of steam pressure it drops to the bottom of the casing and leaves the valve passage open. As the steam pressure accumulates in the outlet connection, at the left, it acts upon the piston, forcing it up into the cylinder on top of the valve and the pressure of steam in the outlet side is governed by the tension of the spring in the housing above its piston. When screwed down this spring holds the piston open until balanced by the steam pressure, whereupon the valve closes.



The "Eclipse" Reducing Valve.

It is stated that the outlet pressure is not affected by variations in the boiler pressure. One superintendent of motive power has remarked that it was so simple that he was almost afraid to trust his men with it. There are but four working parts, the valve, valve pin, spring and screw. This valve is now in use on the Chicago Northwestern, the Cincinnati, Hamilton & Dayton, the Atchison, Topeka & Santa Fe, the "Big Four" and several other roads, and also on ships of the Minnesota Steamship Company. It is manufactured by The John Davis Co., 51 Michigan Street, Chicago.

STUPAKOFF ON WIRE GAUGES.

Mr. S. H. Stupakoff read a paper on wire gauges before the German-American Engineers' Society at Pittsburg, Pa., on March 22, 1899, on which occasion every known gauge received attention from the speaker, who did not fail to hold up as an object lesson those familiar representations that are parodies on the name of gauge. From the ordinary slot guage the speaker touched upon the refinement of the art as exemplified on the micrometer gauge, from which it was but a step to the instrument of the author's devising, called the comparometer, a device intended for comparing different standards, though incidentally it serves to determine the standard dimensions, numbers of standard gauges and various corelated properties of objects dependent on their dimensions. The comparometer, by the inventor's description, combines a micrometer gauge for wire, plate, drills, etc.; it gives the weight for round and sheet metals, the number of threads per inch for standard machine screws and suitable tap-drills therefor, and it furnishes the means for comparing any or all of these data at a glance.

The mechanical principle involved in the comparometer is that of a plain spiral base combined with a radius vector, movable around its pole. A shifting of the radius vector causes some fixed point on it to recede from or advance toward the spiral. The rate of recession or advancement is in direct proportion to the arc traversed. This instrument replaces all gauges which are marked on its face, and as a micrometer caliper it combines with one or all of these gauges an accurate measuring instrument with rivisions of 1,000ths of an inch, 64ths of an inch and 100ths of a millimeter. There is no doubt that this instrument is devised to fill a place never before occupied, and it will also lead to a better understanding of the metric system since readings in those values are directly comparable with the inch and its divisions, and would therefore hasten a familiarity with the system least understood, because transposition is not necessary.

PHENIX METALLIC PACKING.

The packing manufactured by the Phenix Metallic Packing Company of Chicago is highly commended by those who use it as possessing a great degree of efficiency in addition to its simplicity. These qualities have been demonstrated by a number of years of practical tests at the hands of engineers whose opinions carry weight. It is a self adjusting metallic packing, used in conjunction with a rubber combination which gives an elasticity peculiar to a purely fibrous packing. An anti-friction metal is used in the manufacture of this packing which makes oiling unnecessary. Owing to its elastic features, it may be used to replace any fibrous packing, and will require no changes in the stuffing box arrangement to be used in place of other packing.

The development of the iron and steel industries of the United States is considered by the "London Statist" as perhaps the most important economic question of our time. This authority says that America has now so developed her iron and steel industries that she must find fresh outlets for her products. "Such outlets she is finding, as we believe with profit, in foreign markets for certain products. For other products, however, she will need to create a new shipbuilding industry of her own, and what has been done or is being done in that connection we must reserve for future examination. No thoughtful man, acquainted with the American character, who considers the situation can fail to perceive that the greatest competition to be faced by British industry and enterprise in the future is that of American shipbuilding. It may be deferred a few years, but it is bound to come."

The delicacy of modern measuring instruments was strikingly shown in Professor Vernon Boy's determination of the density of the earth. The force which he then measured was, he has stated in a recent lecture, equivalent to a weight of $\frac{1}{12,000,000}$ of a grain acting at the end of a lever 1 inch long.—"Engineering."

PERSONALS.

Mr. A. C. Beckwith has been appointed Division Master Mechanic of the Illinois Central at East St. Louis, Ill.

Mr. Richard English has been appointed Division Master Mechanic on the Rio Grande Western, at Helper, Utah.

Edward S. Tabor, President and Treasurer of the Morse Twist Drill & Machine Company, died in New Bedford, Mass., March 10.

Mr. A. C. Deverell has been appointed Superintendent of the Car and Machine Shops of the Great Northern Railway, at St. Paul, Minn.

Mr. G. J. Kelly has been appointed Division Master Mechanic of the Baltimore & Ohio Railroad, with headquarters at Riverside, Baltimore.

Mr. G. De Vilbis, formerly of the Wabash Railroad, at Peru, Ind., is now in charge of the mechanical department of the Western Division of the Grand Trunk Railway.

The promotion is announced of Mr. E. T. White to the position of Superintendent of Motive Power of the Baltimore & Ohio to succeed Mr. I. N. Kalbaugh, transferred to the lines west of the Ohio River.

Mr. I. N. Kalbaugh, Superintendent of Motive Power of the Baltimore & Ohio at Baltimore, has been appointed Superintendent of Motive Power of the same road west of the Ohio River, with headquarters at Newark, O.

Mr. James Hocking has received the appointment of Master Mechanic on the New York, New Haven & Hartford at New Haven, succeeding Mr. J. W. Leary, who has taken the position of Superintendent of the Aluminum Plate and Press Company, at Plainfield, N. J.

John Kruesi, Chief Mechanical Engineer of the General Electric Company, at Schenectady, N. Y., died in that city February 22, t the age of fifty-six years. He was born in Switzerland, and upon coming to this country in 1870, he entered the employ of Mr. Thomas A. Edison, at Menlo Park.

Mr. Edwin G. Russell has accepted the position of superintendent of the Morris and Essex division of the D. L. & W. Railroad, succeeding Mr. A. Reasoner. Mr. Russell was associated with President Truesdale on the Minneapolis & St. Louis, where the latter gentleman was receiver of that road.

The appointment of Mr. J. W. Fitzgibbon as Superintendent of Motive Power of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., is a new move on that system there having never been a supreme mechanical head on the road. Formerly the several master mechanics on the line reported directly to the General Manager.

Mr. W. L. Derr, who has been Superintendent of the Delaware Division of the Erie R. R., has received the appointment of Superintendent of the Susquehanna Division to succeed Mr. J. T. Maguire, who is transferred to the New York Division, where he succeeds Mr. W. W. Maguire, resigned. Mr. Derr's headquarters will be at Elmira, N. Y.

Professor W. F. M. Goss, of Purdue University, has been granted leave of absence, beginning April 1, for a trip abroad. After twenty years of such active work at Purdue, Prof. Goss merits this rest, and he will return with renewed energy to continue his admirable work. Prof. R. A. Smart will have charge of the department during the absence of Prof. Goss.

Mr. Michael D. Wild has been made Secretary of the Baltimore & Ohio Southwestern, succeeding Mr. Edward Bruce, and Assistant Secretary of the Baltimore & Ohio Railroad, with headquarters at No. 2 Wall Street, New York. For several years Mr. Wild has held a very responsible position with the Baltimore & Ohio Railroad, in Baltimore, and the change is a promotion and recognition of his valuable services.

Mr. J. T. Harahan, Jr., has been selected to represent the Charles Scott Spring Company, in association with Mr. William V. Kelly, with headquarters in the Fisher Building, Chicago.

Mr. W. E. Symons, Superintendent of Motive Power of the Plant System, is now also in charge of the car department by an extension of his jurisdiction, whereby the Master Car Builder reports to him.

Mr. H. A Parker, who has just been appointed Vice-President and General Manager of the Chicago, Rock Island & Pacific, began his railroad service as chainman in the construction of the road in 1866, at the age of fifteen. He has filled many important and responsible positions, such as Division Engineer and Chief Engineer, and Assistant to the President. His recent activities have been in connection with the extensive track elevation improvements in Chicago. The appointment may be considered in the light of a triumph of engineering skill, combined with ability in management.

Mr. William H. Harrison, Superintendent of Motive Power at Newark, Ohio, of the Trans-Ohio Division of the Baltimore and Ohio Railroad, has laid aside his railroad burdens, after a period of forty-five years of service on the B. & O. Mr. Harrison's railroad work began with the Baltimore & Susquehanna Railroad, when he served his aprenticeship. In his long term of active railroad life he has witnessed the transition of the motive power units from the primitive Eastwick and Harrison engine and the "camel back" to the powerful freight engine of the present. Mr. Harrison retires at the age of 67 years, with an enviable record.

Mr. Alexander Kearney, Assistant Engineer of Motive Power of the United Railroads of New Jersey, has been appointed Assistant to Mr. F. D. Casanave, General Superintendent of Motive Power of the Pennsylvania Railroad, with headquarters at Altoona and the title of Assistant Engineer of Motive Power. Mr. Kearney's railroad career began with his apprenticeship in the Altoona shops, after which he was appointed Road Foreman of Engines of the Philadelphia Division, and following that, Assistant Engineer of Motive Power of the Philadelphia, Wilmington & Baltimore.

Sir Douglas Galton is dead. He was born in Worcestershire, England, in 1822, and was educated at the Royal Military Academy, Woolwich, where he passed the highest examination on record, and took first prize in every subject. He received a commission in the Royal Engineers in 1840, and eventually became Inspector of Railroads, and Secretary of the Railroad Department of the Board of Trade, in which capacity he made an official visit to the United States in 1856. In 1860 he was appointed Assistant Inspector of Fortifications, and from 1862 to 1870 he was Under Assistant Secretary of State for War. Later he became Director of Public Works and Buildings, and in 1875 he retired. From 1870 to 1895 he was General Secretary of the British Association, and from 1895 to 1896 he was President of that body. He was also a member of the council of the Royal Society, and constructed the Herbert Hospital at Woolwich. He was the author of "Healthy Dwellings" and "Healthy Hospitals," and other works, and was one of the greatest British authorities on questions of sanitation. The work for which he is best known in the United States was that in connection with the celebrated air brake tests which were carried out by his joint work with Mr. Geo. Westinghouse in England.

Mr. G. R. Henderson, member A. S. M. E., has resigned as Mechanical Engineer of the Norfolk & Western Railway to join the engineering staff of the Schenectady Locomotive Works.

He is widely known in this country and abroad by his valuable contributions to the technical press and his excellent work in the preparation of reports presented to the American Railway Master Mechanics' Association. No more thorough reports have been submitted to the association than those of the committees on tonnage rating last year, and on the proper ratio of heating surface and grate area to cylinder volume presented in 1897, he being chairman of both committees. He has also written many valuable articles for the "American Engineer." Mr. Henderson began his railroad work by an apprenticeship at the West Philadelphia shops of the Pennsylvania Railroad in 1878. In 1881 he went to the drawing room at Altoona to become assistant Chief Draftsman. He went to Roanoke, Va., in 1887 as Assistant Superintendent of the Roanoke Machine Works, and since 1890 he has been Mechanical Engineer of the Norfolk & Western. One of his notable locomotive designs was illustrated in our June, 1898, issue, page 181, and his work in that position has given him the reputation of being one of the foremost locomotive designers. His new title is Assistant Mechanical Engineer and he will assist Mr. Pitkin and Mr. Sague in designing new locomotives. His qualifications as an engineer and his judgment from a wide experience render him a most valuable officer in locomotive building works, but his loss to the railroad service will be serious. Such men are greatly needed, and railroad managers should ask themselves the question: "Why do these good men leave the railroads?"

F. C. Weir, President and General Manager of the Weir Frog Company, of Cincinnati, died March 1, and is succeeded by Mr. L. C. Weir. Mr. Weir was a very able man in his line of business, and his career was one of marked success. He was born at Oxford, Conn., in 1832, and entered the New Haven railroad shops at seventeen years of age, where he learned the machinist trade. He then became locomotive engineer on that road, and in a few years was made foreman of a department of the shops. In 1855 he went to Russia and served under Ross Winans as one of the engineers in building the Russian railway, running from St. Petersburg to Moscow. He was General Manager of the St. Petersburg Division, and after serving in that capacity for several years he returned to this country in 1863. In 1872 he became interested in the manufacture of railroad frogs. In 1883 he organized the Weir Frog Company at Cincinnati, O., and developed that business, giving it his personal and entire attention for many years. Mr. Weir invented a great many frogs, switches and crossings, and machines for manufacturing them, and he thoroughly systematized the business. He was a man of unusual ability in all directions connected with manufacturing. His personal characteristics were very strong, and the attachment between him and his employees as continued through the latter years of his life was very unusual. He seemed to live for the benefit of those around him, and entered into their joys and sorrows with a spirit which only a great and benevolent man can show. He was a public-spirited man, and took the keenest interest in all the economical questions of the day. He was a member of the American Society of Civil Engineers since 1872; was also a member of the Engineers' Club of Cincinnati; the Engineers' Club of New York; Engineering Association of the South; the Engineers and Architects' Club of Louisville.

Mr. William Ledyard Cathcart has been appointed adjunct professor of mechanical engineering at Columbia University, and will be Professor F. R. Hutton's principal co-operator in the department. Mr. Cathcart is well known as a writer upon engineering subjects, the chief of which have been in the line of marine, mechanical and civil engineering. Owing to his training and experience in marine engineering, it is natural to infer that Columbia is to give special attention to marine subjects, which is specially appropriate because of its location in this important seaport. Mr. Cathcart's professional record in the United States Navy began with his appointment as cadet engineer in October, 1873. His service with the Academy ended in June, 1875, was followed by assignments to the North Atlantic station on the "Canandaigua" and "Plymouth," 1875 and '76, and to the "Adams," '76 to '78. He was commissioned as assistant engineer during this interval, in July, 1877. May, 1878 to '81, he was with the flagship "Richmond," on the Asiatic Station. Returning to America he was assigned in November, 1881, to inspection duty at Philadelphia until January, 1884, when again he had three years' sea duty on the U. S. S. "Ossipee" at the Asiatic Station, until 1887. Returning again to inspection duty at Philadelphia, from June, 1887 to April, 1889, he was then transferred to the "Yorktown" until the summer of that year, when he was assigned to duty at the League Island Navy Yard. He passed his examination to the grade of Passed Assistant Engineer in December, 1884, and after becoming interested in a particular line of manufacture, resigned from the Navy to pursue the work of his choice in January, '91. He received an appointment from Mr. William H. Webb, founder of Webb's Academy, as Instructor in Marine Engineering, in the spring of 1897, but on the breaking out of the war he volunteered and was appointed Chief Engineer June 10th, '98, with appointment to the Bureau of Steam Engineering at Washington. He was honorably discharged in October, '98, and received his appointment at Columbia University in February, 1899. He will begin duty in his new position in October next.

BOOKS AND PAMPHLETS.

"The Centrifugal Pump, Turbines and Water Motors, Including the Theory and Practice of Hydraulics Specially Adapted for Engineers." By Charles H. Innes, M. A., Lecturer on Engineering at the Rutherford College, Newcastle on Tyne. Second edition. The Technical Publishing Co., Ltd,. and D. Van Nostrand Co., 23 Murray St., New York, 1898. Price, 3 shillings 6 pence.

This book is divided into seven parts, of which the first treats of general principles concerning motion of water, the second with pressure engines producing rotary motion, the third with turbines and the Pelton wheel. Theory and mathematical considerations are given important places in the work. A chapter from the pen of C. A. Parsons describes his form of steam turbines. A chapter on water turbines shows the close agreement between theory and experiment. Centrifugal pumps, fans, the hydraulic works at Niagara and the hydraulic buffer stop, each have chapters. Trigonometric and graphic methods are freely used. The book might have been devoted entirely to hydraulic pumps and motors to somewhat better advantage. Steam turbines, fans and railroad buffers are all interesting, but a book entitled "Centrifugal Pumps and Turbines" does not appear to be a promising one to aid in the search for literature on fans, buffers and steam engines. This criticism does not, however, reflect discredit upon the other parts of the work. The engravings are not all bad, but many are too wretched to pass unnoticed.

"The Commercial Management of Engineering Works." By Francis G. Burton. The Scientific Publishing Co., Manchester, England, 1899. Price, 12 shillings 6 pence.

The author of this book was formerly secretary and general manager of the Milford Haven Shipbuilding and Engineering Co., and he has written for young engineers and foremen who have not established systems of their own. No attempt has been made to lay down rules, but rather to show difficulties and offer suggestions. The book is arranged in logical order and presents in considerable detail the author's idea of what a complete system of shop and office management should be. The details are, we think, much too complete in respect to very little things and too little is said about others that are most important. The vital importance of knowing costs of work done as a basis for estimating and managing is considered, but too much space is given to clerical and accounting matters to permit an unobstructed view of the broad principles of commercial management. The book is worth reading by those who have already established systems, for it offers suggestions that may tend to improvement. We should say that if the vast amount of detail outlined in this book is necessary to meet

conditions in English "Engineering Works," these conditions are much more complicated than ours. We do not need to be told that all forms of which it is intended to take press copies should be printed in copying ink, but we would like to know how English manufacturers keep record of the cost of production. The general subject of costs is treated, but its effectiveness would be greater if more elaborate. The book is attractive in appearance, the letterpress and binding being excellent. Mr. Burton believes in advertising, for he says: "A saving of advertising expenses generally means a much greater reduction in the amount of orders."

The Testing of Materials of Construction. By W. C. Unwin. Second edition. Longman's Green & Co., New York, 1899. Price, $6.00

In addition to the necessity for bringing this work up to date, the second edition was needed because of the important place assumed in modern engineering practice by experimental investigation into the properties and qualities of the materials used by engineers. The materials themselves have improved and the appliances for testing are not backward in this respect. The author's name is a guarantee of thorough, scientific and sensible treatment upon a careful plan. The plan is to handle the subject scientifically and commercially. The former contains the mathematical and exact treatment, while the latter is a guide in the selection of material for engineering purposes. The broad divisions of the work are, elasticity, deformations and plasticity, hardness, the machinery and apparatus for testing, and a wide range of results of tests upon the materials of engineering that are in general use. It is a large book, and would have been much larger if the author had fully treated all that we would like to have him include. Iron and steel very naturally occupy a large share of space, both in the section given to records and the curves of behavior of specimens and in the part given to the manipulation of testing. The progress of 10 years since the first edition appeared has been thoroughly brought up to date, except in regard to the improvements chemically, which are omitted. It is a valuable work and will be obtained by every up-to-date engineer. It is a scientific study of testing and a work of record which is likely to stand a long time as an authority in practice. The printing and binding are excellent, and most of the engravings are good, while others are out of place in such an admirable book. It has a good index.

List of Officers and Members of the American Society of Naval Engineers, 1899.

This pamphlet, received from Chief Engineer A. B. Willits, U. S. Navy, contains a list of officers, members and associate members of the society and lists of the exchanges and subscribers to the proceedings.

"The Tokio Imperial University Calendar, 1897-1898. Published by the University, Tokio, Japan."

Opening with a calendar of the opening and closing months of the college year, there is an interesting historical summary of the life of the institutions forming the University, tracing its development from its origin by the union of the late Tokio Daigaku, Kobu Daigaku and Tokio Nornigakko.

"Twentieth Annual Report of the State Board of Agriculture College, Including the Eleventh Annual Report of the Agricultural Experiment Station, Ft. Collins, Colorado. 1898."

The report covers the aims and purposes of an agricultural college ,and gives evidence of more than usual care in its preparation.

Society of Naval Architects and Marine Engineers, Names of Members, 1899.

This little pamphlet contains the names and addresses of the members, the constitution and rules and a list of the papers contained in the five volumes of the proceedings of the society. This is one of the most important of the technical engineering societies, and the record of subjects presented at the five annual meetings shows the scope and character of the discussions. The secretary is Mr. Francis T. Bowles, 12 31st street, New York.

Prospectus of the Working Men's College, Melbourne, Australia. Twelfth edition. 1899.

This college was founded to improve the education of those who work, and especially to facilitate the attainment of a knowledge of handicrafts, arts, sciences and languages, by the establishment of classes, workshops, laboratories, reading rooms, libraries, museums, and by other means, as the council may direct. The curricula embrace manual training, as well as the higher courses, and both sexes are admitted.

Statistical Abstract of the United States, 1898. Twenty-first Number. Population, Finance, Commerce, Agricultural and Other Leading Products, Mining, Railroads and Telegraphs, Immigration, Education, Public Lands, Pensions, Postal Service, Prices, Tonnage, etc. Prepared by the Bureau of Statistics, under the direction of the Secretary of the Treasury, Washington. Government Printing Office, 1899.

Under the above comprehensive statement of the contents of this work is to be found information of interest to the banker, the business man and the farmer, covering as it does every aspect of foreign and home trade.

"On the Organization of Engineering Courses, and on Entrance Requirements for Professional Schools." By Dr. R. H. Thurston, Director of Sibley College, Cornell University, Ithaca, N. Y.

This is a pamphlet reprinted from a paper which has for its object, as stated in the opening paragraph, a consideration from a professional standpoint of the necessity of organization of professional schools, and those of engineering particularly. Consideration is also given to the proper method of organizing such professional institutions and especially their curricula, and the logical and best methods of discovering their essential, and their desirable, though non-essential, entrance requirements, and, finally, of securing a proper and the best method of relating their courses of instruction to those or the academic schools, preparatory and others. The arguments in consonance with the objects named above, were clearly put in the usual style of the distinguished author, but are too lengthy for even a fragmentary review, although very interesting.

Register of the Lehigh University, South Bethlehem, Pa., 1898-1899. This register fully explains the founding of the university and its incorporation in 1866 by the Legislature of Pennsylvania. The curriculum embraces civil, mechanical, mining and electrical engineering, metallurgy, chemistry and all needful collateral studies. A school of General Literature is also established and thoroughly equipped, and the classical course, the Latin-Scientific course, and the course in Science and Letters.

Dixon's "Teachers' Note Book." Joseph Dixon Crucible Company, Jersey City, N. J.

This is an interesting pamphlet and neatly gotten up. It is devoted entirely to a description of the materials entering in, and the manufacture of the Dixon American Graphite Pencils.

The Peerless Rubber Company has issued a little explanatory folder of their Rainbow packing and gaskets and the information is conveyed by means of plain language, without extravagant claims of superiority or attempts to belittle other products in the same line. The little flyer is printed in brilliant colors, and is sure to attract attention to the output of this well known house.

A pamphlet from the B. F. Sturtevant Company, of Boston, furnishes some interesting figures, resulting from observations made in fuel tests under mechanical draft, of the 1,000-horse power plant of the United States Cotton Company, at Central Falls, R. I. An annual saving of $6,500 was shown by the use of a fan costing $550, by which an inferior mixture of coal was made to replace the Cumberland coal used before. The speed of the fan engine is regulated automatically and accommodates itself to the steam pressure. Notwithstanding there is no economizer used with the mechanical draft, the gases are said to have a temperature not higher than 400 degrees Fah.

The Detroit Graphite Manufacturing Company, Detroit, Mich., have issued an attractive pamphlet containing a large number of excellent half-tone engravings illustrating a portion of the important buildings, bridges, ships, railroad cars, gasometers and other structures which have been painted with "Superior Graphite Paint." It also contains statements of the merits of this paint as a durable metal coating. The array of

important works upon which the paint has been used is a convincing argument, and added to this are reports of severe tests imposed upon it, such as the exposure of pieces of iron coated with it when placed in boiling sulphuric acid. The acid eats away the iron entirely, and a piece painted on one side is completely decomposed, leaving only the film of paint uninjured. The pamphlet should be obtained and examined by all who are concerned with the protection of metallic structures. It is very attractively printed, and the engravings are interesting, aside from their exhibit of the protective properties of the paint. We think the best testimonial to the value of this paint is the fact that the consumption for 1898 was double that of the previous year. The company is now constructing a large five-story addition to the factory, in order to provide for the increasing demand.

Air Compressors, Air Hoists, Air Appliances.—The Curtis & Co. Manufacturing Co., Engineers and Machinists, St. Louis, Mo., have issued a catalogue of the regular product of their works which is well worth sending for. The chief of these specialties are automatic air compressors driven by belts, steam engines and gas or gasoline engines. The firm produces a line of compressors which are unique for their simplicity, compactness, and we should say also for efficiency, as far as this may be judged by examination of the interesting designs. The details and methods of operation have been studied with care and the result is a series of machines that are sure to interest those who have occasion to use air compressors. The valves are simple and easily accessible, the principle of governing is to relieve the machine from doing work when the desired pressure is secured, without stopping the machine, and the clearance of the machines is kept down to about 1½ per cent. The parts of the machines are standardized, so that repairs may be promptly made and the tests at the works are said to be so rigid as to eliminate breakdowns. The gas engine combined with the compressor, is a very compact and convenient machine that is adapted to many kinds of service where a steam boiler cannot be used. The catalogue also includes a number of air hoists and shows their applications to cranes and travelers. It also includes line drawings, showing the foundation plans of the various sizes of compressors and concludes with some strong testimonial letters from well known manufacturing concerns.

The Dayton Malleable Iron Company, Dayton, Ohio, have issued a new series of circulars, illustrating their product in malleable iron for railroad use. These are all standard size, (6 by 9 inches), and we do not know of any better way to present the advantages of these specialties. The engravings are excellent and are clear enough to show the advantages of this material with very little description. The one describing the car door fastener is specially well done, both as to engravings and arrangement, all of the parts being lettered for convenience in ordering. This fastener is well known; it is self contained and does not require pins, hooks or chains, the locking being effected by a gravity button, which is loosely attached to the door fastener. This fastener is recommended by 12 years of satisfactory service. Among the circulars several others may be mentioned. The Dayton brake wheel is a needed improvement over ordinary cast iron wheels and is sold at a low price. The Kelly brake fork, which was illustrated on page 63 of our February, 1898, issue, offers the advantages of strength, (they have been tested to 40,000 pounds), combined with an absence of welds, and there are no welds in the rods to which they are connected, as an examination of our description will show. Gunn's roof saddle, or running board bracket, was illustrated on page 277 of our August issue last year, and it received strong indorsement from Mr. A. E. Mitchell, Superintendent of Motive Power of the Erie R.R., which will be found on page 227 of the proceedings of the Master Car Builders' Association for 1898. Mr. Mitchell stated that this bracket was introduced on the Erie in 1894, and that it had been applied to every car receiving general repairs in the shops of that road since then. Drawings illustrating the bracket and the manner of attachment are printed on pages 228 and 229 of the volume of proceedings referred to. In wrenches for shop and track work these manufacturers are prepared to supply any size or form; also, ends for track gages, ground switch latches, rail braces, coal picks, fire shovels and drinking cups. These are all presented in the circulars, together with shop and engine torches, all of malleable iron. The circulars are well printed and are attractive.

EQUIPMENT AND MANUFACTURING NOTES.

The Swedish State Railways have placed an order for 20 compound locomotives with the Richmond Locomotive Works.

The Pennsylvania Railroad is said to have in view the construction of 123 new locomotives this year at their Altoona shops.

The Magnolia Metal Company has changed the address of the Chicago office to the Fisher Building, 281 Dearborn street. They were formerly in the Trader's Building.

The satisfactory condition of business of the Q & C Co. and the attitude of that concern toward its employees, is shown by a recent advance in wages of the manufacturing force of about 10 per cent.

The Howard Iron Works, Buffalo, N. Y., large manufacturers of vises, bolt cutters and other machinery, have had 25 years' experience in this line, and are prepared to furnish tools of this kind that are thoroughly well known to be satisfactory and efficient.

The Ohio Falls Car Works is now the property of the American Car and Foundry Company. According to the "New York Commercial" the purchase price is $2,500,000, which was turned over to the old owners of the Jeffersonville plant March 21. It was a cash transaction.

The McCord journal box is to be applied to 1,000 cars building for the Lake Shore, on 2,000 for the St. Louis, Peoria & Northern, 800 for the Minneapolis & St. Louis, 400 for the Duluth, South Shore & Atlantic, and a number of other smaller lots for which contracts have been recently closed.

The Philadelphia works of the Charles Scott Spring Co. were destroyed by fire March 13. The company announces that proparations have already been made to rebuild the plant, and in the meantime temporary arrangements have been made to carry on the work on orders, so that there will be no delay whatever in filling them.

The Automatic Rail Joint Spring Company, of Chicago, have received orders for their springs from the Denver & Rio Grande. The springs have also been placed in service on the Chicago & Northwestern, the Atchison, Topeka & Santa Fe, the Chicago, Rock Island & Pacific, the Illinois Central and the Wisconsin Central roads. We are informed that it has given satisfactory results in every case.

The Ingersoll-Sergeant Drill Company have issued booklet No. 153, which contains an index to their catalogue, No. 41. This booklet contains some fine half-tones of their new drills and compressors, in addition to their descriptive matter and testimonials from users of their machines. The index clearly refers those interested directly to the designation numbers of the special catalogues that will furnish the desired information.

Mr. George Place has been appointed Eastern agent of the American Tool Works Company of Cincinnati, with office in the Equitable Building, 120 Broadway, New York. Mr. Place has an unusually wide and valuable acquaintance and is one of the best known representatives in the machine tool business, having been connected with Bement Miles & Co. for more than 16 years. He accepted the position after a most careful investigation of the product of the American Tool Works Company, in which he found their product equal to the best from any manufacturers, and with their ample facilities and his own abilities the office will undoubtedly conduct a large amount of business. Mr. Place is also agent for the J. A. Fay & Eagan Company, the largest manufacturers o f woodworking machinery, and is prepared to furnish complete machinery for car and locomotive shops.

The Baltimore & Ohio has decided upon changing the system of running a pay car to the modern one of paying by checks, the distribution being done by the station agents. Where about

a million dollars per month was disbursed by a pay car, requiring three weeks for the circuit, the old system became too burdensome and awkward.

Eastern business men when traveling between Chicago and St. Louis should go via the Chicago and Alton. The trains are convenient and comfortable and they run on time. They will find the accommodations equal if not superior to those of the best Eastern trains, because some of the best work of the Pullman Company has been put into the cars used on this road.

The Charlotte Machine Company, one of the largest mill machinery and construction houses in the South, which has equipped many of the leading mills, decided to go into voluntary liquidation March 22. Capt. H. S. Chadwick, the principal stockholder, committed suicide in Boston several weeks ago. The North Carolina Car Company, car builders and wheel manufacturers, of Raleigh, have been placed in the hands of a receiver.

The Hornish Boiler Cleaner, which was illustrated and described in our issue of December, 1898, page 413, is attracting attention abroad as well as at home. We are informed that Mr. C. E. Cardew, member I. C. E., Locomotive and Carriage Superintendent of the Burma Railways of India has sent drawings of two types, Classes F and O, of locomotive boilers of that road, to Mr. Hornish in order to permit of designing the boiler cleaner for use on the engines of that road.

The Baltimore & Ohio track improvements are being continued. The next rectification of line to receive attention is at the "Doe Gully" curves, where preparations have now been going on for about three months. The Chief Engineer says that the improvement will do away with one of the most objectionable pieces of track on the second division since the Seven Curves were eliminated, and will remove four reverse curves. It will not only make a much better riding track for fast trains, but materially assist the westbound freights in climbing this grade.

One of the results of the recent inspection trip of the Baltimore and Ohio Railroad lines west of the Ohio River is an order for a double track on the Central Ohio division from Bellaire to Cambridge, Ohio, a distance of fifty-three miles. This portion of the road is congested with freight at all times, and the proposed improvement is in the nature of a necessity. It is estimated that the second track will cost in the neighborhood of one and a quarter million dollars. There are a number of heavy grades between Bellaire and Cambridge which will be cut down, and all of the bridges will be replaced with new double track steel structures. It will take at least a year to complete the work.

The Pencoyd Iron Works have sent a gang of men to Africa for the purpose of building a bridge across the Atbara River, in the Soudan, near Khartum. The seven spans of the bridge, with a total length of 1,110 feet, have already been shipped. The order was placed with the Pencoyd Iron Works by the British War Office less than six weeks ago, the company agreeing to build the structure in seven weeks. The Pencoyd Company was given preference over the English bridge builders because the latter had stated that it would require seven months to complete the structure. The British War Office was anxious to have the bridge completed before Fall, in order to facilitate the operations of Gen. Kitchener.

The Westinghouse Air Brake Company have issued a series of three bulletins in pamphlet form (6x9 inches) that cannot but be of great aid to those interested in the care and use of air pumps. Bulletin No. 1 treats of the maintenance of pumps in concisely worded suggestions. Bulletin No. 2 is devoted to the testing of air gauges, pump governors and reducing valves, explaining the mechanical operations involved in the work. Bulletin No. 3 concerns the capacity and location of main reservoirs in locomotives, giving reasons why certain locations of the reservoir are objectionable, and why in some particular cases a large reservoir capacity is not only desirable but necessary to the best operation of the brake.

The Ajax Metal Company, encouraged by the success of their well known bearing metal and Ajax tin have placed on the market a metal under the trade name of "U. S. Tin" for use in the manufacture of all castings in which tin is one of the elements. An incentive to purchasers to use "U. S. Tin" is furnished in the price, which is made so far below that of the imported tin that there can be no doubt of the immediate success of the new brand, more especially when it is known that it will make a superior metal, castings sounder and more homogeneous, and a better wearing metal, much richer in color and of greater tensile strength; besides, it can be used in the same proportions as the imported tin. Small lots of "U. S. Tin" will be sent on approval to responsible people in order to convince all that it is superior to imported tins.

The order for ten high-speed passenger locomotives recently placed by the French State Railways with the Baldwin Locomotive Works is believed to be the first built outside of France for French railways. The order was placed by a commission that represents the French Government and is now in this country. The commission consists of MM. Boell, Assistant Engineer-in-Chief of Motive Power; Charrier, Division Superintendent of Traffic. and Thore, Inspector of Motive Power. The prospective rush of travel during the Exposition is the reason for these timely preparations by the European roads. The head of the commission said, with reference to the respective performance of the American and French engines, that they can tell only after exhaustive tests whether the American engines are superior to the French for their service, where consumption of fuel is a matter of prime importance. His opinion is that the American engine uses more fuel than the French engine, but it remained for a trial to demonstrate that point.

Walter A. Zelnicker, 202 North Third street, St. Louis, Mo., manufacturer and agent for railway, mill and factory supplies, including boilers, engines and machinery, reports a very satisfactory condtion of business. He is prepared to furnish everything used in the construction, operation and maintenance of railways and shops. Among his well-known specialties are "Zelnicker" prepared roofing, which is strongly recommended for car sheds, roundhouses and warehouses. Besides being durable, it is low in cost and is claimed to be the cheapest and best for these purposes. Mr. Zelnicker is agent for "Positive Lock Nut Washers," the "Johnston" wrench, the Cyrus Roberts hand and push cars, also for the product of the Trenton Iron Company and for track velocipedes, steel wheelbarrows, brake chains, spikes and rail splices. He makes a specialty of the "Zelnicker" second growth hickory maul handles, one of which is guaranteed to be equal in durability to six ordinary handles. This may be considered a small item, but it is an important one.

Trials of the Babcock & Wilcox boilers of the marine type are noted in "The Mechanical Engineer." The torpedo gunboat Sheldrake, which was specially commissioned at Devonport on the 14th ult. for experimental purposes, has now been ordered to carry out a series of trials, under service conditions, of the Babcock & Wilcox boilers, with which she was equipped during her refit last year. There will be in all nine runs, each of 1,000 miles continuous steaming, at various horse powers from 1,500 to 2,100, the speeds being from 12 to 17 knots approximately. During these runs only three of the four boilers with which the ship is fitted will be used, the same three boilers for all trials. The Sheldrake's four boilers are each capable of developing 1,000-horse power, using natural draught. The vessel has just completed the first of the series of trials. The run of 1,000 miles was made betwen Plymouth and the Isle of Man under favorable conditions, with three-fourths of the boiler power of the ship. An average of 1,500.3 horse power was realized. The boilers in use gave a grate surface of 189 sq. ft. and a heating surface of 6,528 sq. ft. The coal consumption was 12.31 lbs. per square foot of grate surface, and 1.61 lbs. per indicated horse power. The total amount of coal used during the run of 1,000 miles was 71 tons 14 cwt., which is regarded as highly satisfactory. It is believed that the coal consumption will be further reduced during the trials, for the second of which the vessel is now being prepared.